Index to Volume XXIX

JULY TO DECEMBER

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Illustrated articles are designated by an asterisk (*), editorial by dagger (†), and industrials by double dagger (‡).

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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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JOURNAL OF ELECTRICITY
POWER AND GAS
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VOLUME XXIX SAN FRANCISCO, JULY 6, 1912 NUMBER 1

WESTERN BOILER INSPECTION AND SUPERVISION

BY J. B. WARNER.[1]

A few years since very little was done in the effort of proper steam boiler inspection on the Pacific Coast outside of the boilers inspected by the United States government in the marine service.

For many years no particular rules or designs were followed in the construction of boilers, each factory or boiler shop designing and carrying out its own particular ideas, in many cases without reference to the most efficient form of construction. Owing to the fact that higher pressures were gradually demanded, better material, workmanship and construction became necessary.

The United States government, being the first to formulate rules and regulations in 1836, has gradually enlarged and developed these rules along more practical lines. At the present time, while the government laws are not all that might be desired, they are far ahead of those in operation a few years ago and are generally followed for stationary as well as marine purposes.

A Notable Boiler Explosion Near Sixteenth Street Depot, Oakland, California, in 1889.

The first systematic boiler inspection on the Pacific Coast was inaugurated about 1884 through the efforts of the boiler insurance companies. Since that time, the larger portion of the steam users have availed themselves of the advantages to be derived along these lines.

The number of steam boiler explosions on the

[1]Chief Inspector San Francisco department, Hartford Steam Boiler Inspection and Insurance Company.

Pacific Coast in proportion to the number of boilers used in the eariler period was excessive, but owing to the fact that most of the boilers are now periodically inspected, the number and proportion of explosions has been materially reduced.

The demand for higher steam pressure has developed a better class of material and workmanship and with the use of the knowledge gained by experience suitable rules have been formulated for the design and construction of boilers. The safety factors have been increased so that at the present time, if the boilers are properly constructed and handled and the pressure kept within the proper safety limit, the liability of explosion is less than in former days. The aggregate of the boiler horsepower on the Pacific Coast has doubled within the last 15 or 20 years, but the number of explosions have been reduced.

We append a summary of the boiler explosions in the United States as reported in the "Locomotive," from 1879 to date:

A Summary of Boiler Explosions, From 1879 to 1911, Inclusive.

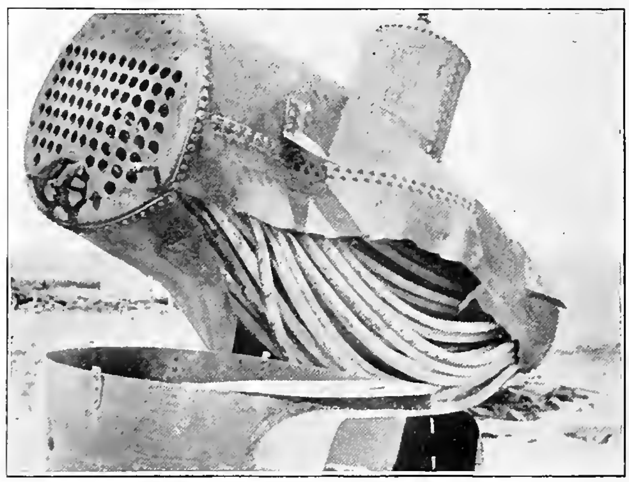
Year.	Number of Explosions	Persons Killed.	Persons Injured.	Persons Kiled and Injured.
1879	132	208	213	421
1880	170	259	555	814
1881	159	251	313	564
1882	172	271	359	630
1883	184	263	412	675
1884	152	254	251	505
1885	155	220	278	498
1886	185	254	314	568
1887	198	264	388	652
1888	246	331	505	836
1889	180	304	433	737
1890	226	244	351	595
1891	257	263	371	634
1892	269	298	442	740
1893	316	327	385	712
1894	362	331	472	803
1895	355	374	519	893
1896	346	382	529	911
1897	369	398	528	926
1898	383	324	577	901
1899	383	298	456	754
1900	373	268	520	788
1901	423	312	646	958
1902	391	304	529	833
1903	383	293	522	815
1904	391	220	394	614
1905	450	383	585	968
1906	431	235	467	702
1907	471	300	420	720
1908	470	281	531	812
1909	550	227	422	649
1910	533	280	506	786
1911	504	223	420	643
Totals ...	10,569	9,444	14,613	24,057

The records of the explosions on the Pacific Coast for the same period are as follows:

Boiler explosions 450
Persons killed 650
Persons injured 923

Total killed and injured 1573

In previous years wood and coal were used almost exclusively for fuel. At the present time oil has taken their place, both in land and marine work. While oil is more severe than wood and coal on a boiler if improperly used, it gives good satisfaction under proper management and will develop a greater amount of power in a given size boiler, owing to the fact that there is a steady fire which is generating steam at all times. With wood or coal as fuel it is necessary to replenish the fires, allowing a large amount of cold air to enter the furnaces which is not only detrimental to the steaming qualities but also very hard on the boiler itself, due to the sudden contraction of the plates and other parts of the boiler. With the oil fires, the admission of cold air is practically excluded from the furnace so that the boiler is kept expanded at all times, making the liability of rupture through undue contraction much less.

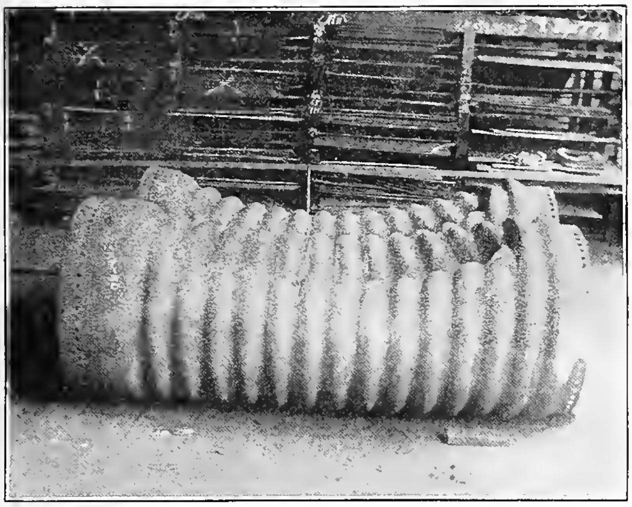


A Recent Boiler Explosion in the California Oil Fields.

Owing to the higher pressures demanded, due to the use of compound, triple expansion, and turbine engines, the construction of the boilers has been materially improved and their efficiency increased. The material entering into boiler construction is of a much superior quality than in former years. The rules for construction are better understood so that taken as a whole results are being obtained today that were impossible a few years ago.

The cause of a boiler explosion is generally attributed to low water, since in most cases, the actual cause of explosion, is not known or hard to determine this appears to be the easiest excuse or explanation of the phenomenon. But in a large majority of the explosions, after careful and thorough investigation, we find that there are many other reasons which cause disastrous results, among which are: internal and external corrosion, development of cracks along the longitudinal seams, along the sides of the boilers, owing to the fact that lap seams are used instead of butt-strip. Whenever a lap seam is used there is an off-set in the sheet and usua. .. flat surface in the side of the boiler which when under pressure has a tendency to form into a cylindrical shape. This causes a hinge motion which by continual use soon develops cracks, causing the sheets to let go.

Scale and oil in the boilers often keep the water from coming in contact with the internal surface, allowing the fire to overheat and weaken the material to such an extent that it bulges and oftentimes ruptures. Defective safety valves, water gauges and other fittings are also conducive to over pressure, low water, or some other cause, which necessitates the boiler withstanding a greater pressure than it should.



Defective Furnaces From S.S. "City of Everett," San Francisco Bay.

Leaky blow-offs often allow the water to get out of the boiler during the night so that the watchman or fireman whose duty it is to put fires under the boilers, do so when the water is either low or entirely out of them. This allows the sheets to be overheated and often causes great trouble or disastrous results. Suitable and tight blow-offs are very important in the safe and economical running of a boiler plant. Oftentimes the lower connection to the glass water gauge becomes choked with sediment so that the water stands in the glass and, owing to the condensation, the glass gradually fills (as the water cannot back into the boiler) while the water in the boiler itself is lower so that the fire sheets become exposed, overheated and let go.

In order to reduce and minimize the number of boiler explosions, loss of life, personal injury, and loss to property, the inspectors from time to time have formulated and put into operation suitable rules which are followed and recognized at the present time as an authority on the construction and management of boilers. These have done a great deal to reduce the number of explosions and loss of life throughout the country, and are as follows:

Boiler Room Instructions.

Whenever going on duty in the boiler room, find out, first of all, where the water level is in the boilers. Never unbank nor replenish the fires until this is done Make sure that the gage glass and gage cocks, and all the connections thereto, are free and in good working order. Do not rely upon the glass altogether, but use the gage cocks also, and try them all, several times a day.

Before starting up the fires, open each door about the setting and look carefully for leaks. If leaks are discovered, either then or at any other time, they should be located and repaired; but cool the boiler off, first. If leaking occurs at the fore-and-aft joints, the inspecting company should be notified at once. This is important, whether the attendant considers the leakage serious or not; and it is especially important when the boiler has a single bottom sheet, or is of the two-sheet type.

When a boiler has been emptied of water, do not fill it again until it has become cold.

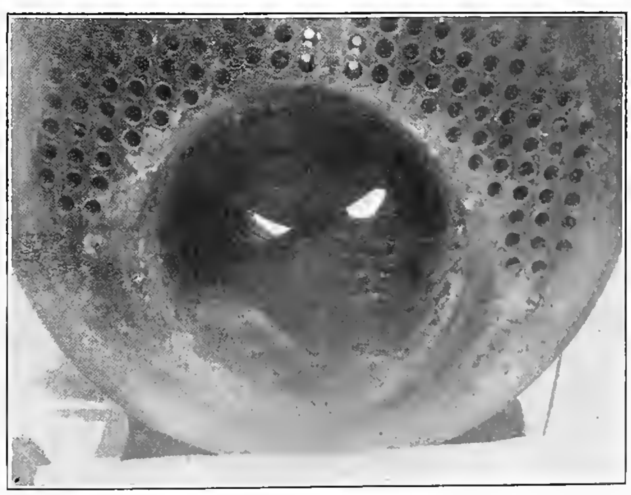
In preparing to get up steam after the boiler has been out of service, be sure that the manhole and handhole joints are tight. Do not use gaskets that are thin and hard.

Vent the boiler in some way, first, to permit the escape of air. Then fill the boiler to the proper level, open the dampers, and start the fires. Start them early, so as to have the pressure up at the required hour, without forcing.

Ventilate the setting thoroughly before lighting the fire. Never turn on the fuel supply when starting up, nor after the snapping out of a burner, without first placing in the furnace a lighted torch or a piece of burning waste, to ignite the fuel instantly.

In firing up a boiler that is to be connected with others that are already in service, keep its stop-valve closed until the pressure within the boiler has become exactly equal to that in the steam main. Then open the stop valve a bare crack, and slowly increase the opening until the valve is wide open. The complete operation should occupy two minutes or more. Close the valve at once if there is the slightest evidence of any unusual jar or disturbance about the boiler. See that the steam main to which the boiler is to be connected is thoroughly drained before the valve is opened.

In case of low water, immediately cover the fire with ashes or fresh coal. Close the ash-pit doors and leave the fire doors open. If gas or oil is used as fuel, shut off the supply from the burners. Don't turn on



Defective Boiler Dredger "Thor," March, 1912.

the feed under any circumstances, and don't open the safety-valve nor tamper with it in any way. Let the steam outlets remain as they are. Get your boiler cool before you do anything else.

No repairs of any kind should be made, either to boilers or to piping, while the part upon which the work is to be done is under pressure. This applies to

calking, to tightening up bolts under pressure, and to repairs of any kind whatsoever.

The safety-valve must not be set at a pressure higher than that permitted by the insurance company's policy. Try all safety-valves cautiously, every day. If the actual blowing pressure, as shown by the gage, exceeds the pressure at which the valve is supposed to blow, inform the office immediately, so that prompt notice may be sent to the company. The safety-valve pipe should never have a stop-valve upon it.

To remove sediment from the bottom of the boiler, open the blowoff valve in the morning, or before the circulation has started up. The valve should be opened wide for a few moments, but it should be opened and closed slowly, so as to avoid shocks from water-hammer action. When surface blowoffs are used, they should be opened frequently, for a few minutes at a time.

In case of foaming, check the draft and cover the fires with fresh coal, or shut off the burners if oil or gas is used as fuel. Shut the stop-valve long enough to find the true level of the water. If this is sufficiently high, blow down some of the water in the boiler, and feed in some fresh. Repeat this several times if necessary. If the foaming does not stop, cool the boiler off, empty it, and find out the cause of the trouble.

Cylinder oil must be kept out of the boilers, because it is likely to cause overheating of the plates. Oily deposits may be removed, in large measure, by scraping and scrubbing, although more efficient methods of treatment may be required in bad cases. If kerosene is used in a boiler, keep all open lights away from the manholes and handholes, both when applying the kerosene, and upon opening the boiler up afterwards; and ventilate the inside of the boiler thoroughly, after oil has been used in it.

Fusible plugs should be filled with pure tin. They should be renewed or refilled as often as may be necessary to keep them in good condition.

Clean the fires before banking, push them back against the bridge wall, and cover them well with fresh coal. Keep the ash-pit doors closed, and open the fire doors a crack. Keep the damper nearly closed, but do not close it tight.

In cooling a boiler before emptying it, first let the fire die out, and then close all doors and leave the damper open until the pressure falls to the point at which it is desired to blow. Clean the furnace and let the brickwork cool for at least two hours before opening the blowoff valve. If it is desired to cool the boiler further, after it has been emptied open the manhole and leave everything else as in full actual service,—the fire doors, front connection doors, and cleaning doors being closed, and the damper and ash-pit doors open.

First cool the boiler as explained in the last paragraph. Never blow out under a pressure exceeding ten or (at most) fifteen pounds by the gage.

The engineer must find out for himself how often his boilers need to be opened and cleaned. In many plants it is necessary to clean every week, while in some favored few it is sufficient to clean every three months. When using kerosene or large amounts of scale solvent, or when (as in the spring-time) the water becomes unusually soft, the boilers must be opened oftener than usual. In washing out a boiler, wash the tubes from above, as well as from below.

Never touch any valve whatsoever, in any part of the room, while a man is inside of a boiler, nor even after he has come out again, until he has reported that his work is finished and that he will not enter the boiler again. It is well to lock the stop-valve and blowoff valve upon every boiler in which a man is working, while other boilers are under steam. Padlocks and chains may be used for this purpose.

In water-tube boilers the covers opposite the three rows of tubes nearest the fire should be taken off once a month, and the tubes thoroughly scraped and washed out; and all the tubes should be thoroughly scraped and washed out at least once in four months. This is for water of average quality. If the water is bad, clean the tubes oftener.

When mechanical hammers or cleaners are employed for removing scale from tubes, the pressure used to operate them should be as low as will suffice to do the work. Do not allow the cleaner to operate for more than a few seconds upon any one spot, and see that it goes entirely through the tube. Avoid high temperatures in the steam or water used to operate the cleaner.

In putting a boiler out of service, it should be cooled, emptied, and thoroughly cleaned, both inside and outside. The setting should likewise be cleaned in all its parts. Leave the handhole covers and manhole plates off. After washing the interior of the boiler, let it drain well. Then see that no moisture can collect anywhere about the boiler, nor drip upon it either internally or externally. Empty the siphon below the steam gage if the boiler room is likely to be cold, or take the gage off and store it safely away.

Do not allow moisture to come in contact with the outside of the boiler at any time, either from leaky joints or otherwise. Keep the mud drums and nipples, and the rear ends of horizontal and inclined tubes in water-tube boilers, free from sooty matter. If internal corrosion is discovered, notify your employers at once.

Examine your boilers carefully in all their parts, whenever they are laid off, and keep them as clean as possible, both inside and outside. See that all necessary repairs are made, promptly and thoroughly. Keep the water glass and pressure gage clean and well lighted. If any contingency arises that you do not understand, report the matter to your employers at once; and if you think it possible that serious trouble may be impending at any time, shut down the boiler immediately.

Inform yourself respecting any local laws or ordinances relating to the duties of engineers and firemen, or to the plant in which you work. If there be any such, attend to them faithfully.

PUBLIC WELFARE EXPOSITION.

A public welfare exposition of pure foods, sanitary, safety and building appliances for improving the conditions of home life, and assisting those engaged in public work and improvements, will be held at the University of California at Berkeley, Sept. 23 to 28. There will also be exhibits of machinery and supplies used in the administration of municipal government.

WESTERN LAWS OF ELECTRICITY AND WATER

COMMERCIAL IRRIGATION ENTERPRISES.

BY. A. E. CHANDLER.

A study of the historical development of irrigation in the western states shows that the small mountain streams along the overland trails and at or near the trading posts were the first to be used for agricultural purposes. As mines were discovered and operated the waters of the streams in the larger valleys were diverted by simple ditches on the lower or bottom lands. Later two or more settlers joined in the construction of larger ditches for the irrigation of land higher up on the stream, and in this way all easily accessible lands in the valley were irrigated. These individual and partnership ditches were sufficient for the lower lands.

It soon became known that the higher, or mesa lands were better than the bottom lands, but the problem of digging ditches to them offered too many difficulties for local accomplishment. It was at this point that eastern and foreign capital was secured for the construction of irrigation canals to reach the higher lands. The size and number of such systems built during the eighties indicate that the promoter had an easy task, and when we consider the time and results of the early irrigation his success must be taken as a matter of course. The simple ditches then in use were the single instrument by which land worth nothing had been brought into a high state of cultivation and great value. It was easy therefore to picture the rich returns of thousands of acres of such land, now barren and worthless, when under a well constructed canal. No argument was necssary to convince the investor that the real wealth lay in the water and that a system of selling water for irrigation was better than a gold mine.

We now know that most of the systems thus built were financial disasters and that the failure was not due to either lack of land or water, or want of engineering skill. The chief error was the neglect to "tie" the land to the water. The promoters and investors were right in believing that the land without the water must remain valueless, but they erred in thinking that the settlers on the land under the system would promptly take water on any terms dictated. The settler, unfortunately, was in most cases a mere "sooner," a waiter of fortune who hurried to the choice land, there to stay until bought out by the real home builder. During the eighties most of the land to be covered by the larger systems was government land and there were no statutes by means of which the canal company could protect itself against filings by "sooners" or secure a lien upon the land for its unpaid water charges. Every western state affords illustrations of large sums lost to its investors in such irrigation enterprises (now called commercial enterprises) and intelligent capital today will invest in no scheme where land and water do not go together. In fact, the attractive enterprise today is really a land deal to which the construction of the irrigation system is but incidental.

The following table (from the census statistics) shows the total area irrigated in 1909, the area irrigated in 1909 by commercial enterprises, and the percentage of the total irrigated by the latter. The commercial enterprise differs from the mutual or co-operative enterprise in that the former supplies water for compensation to parties having no interest in the works and the latter supplies water to stockholders only.

Acreage Irrigated in 1909.

State.	Total.	Commercial Enterprises.	Percentage by Commercial Enterprises.
Arid States	13,739,499	1,444,806	10.6
California	2,664,104	746,265	10.6
Washington	334,378	66,911	20.0
Texas (exclusive of rice)	164,283	73,440	16.3
Oregon	686,129	77,387	11.3
South Dakota	63,248	6,300	10.
Nebraska	255,950	24,834	9.7
Wyoming	1,133,302	87,935	7.8
Utah	999,410	70,227	7.0
Colorado	2,792,032	159,457	5.9
Montana	1,679,084	62,544	3.7
New Mexico	461,718	15.690	3.4
Idaho	1,430,848	44,872	3,1
Nevada	701,833	8,864	1.3
Arizona	320,051	80	.1
Kansas	37,479	......	....
North Dakota	10,248	......	....
Oklahoma	5,402	......	....

As California has comparatively so large a percentage of commercial enterprises, it might be inferred that such projects are especially numerous and popular. The fact is, however, that the large acreage so served is under a small number of unusually extensive systems and that the mutual systems are the rule.

The commercial enterprises may be divided into three groups as follows:

First. Enterprises furnishing water on annual rental basis only;

Second. Enterprises selling water rights and charging either a fixed or variable annual rate in addition;

Third. Enterprises selling water rights and a pro rata interest in the irrigated system. The enterprises of this group therefore become mutual enterprises.

A few California examples of each group follow:

Examples of Companies "Renting" Water.

The Kern County Land Company diverts water from the Kern River for the irrigation of about 250,000 acres in the vicinity of Bakersfield. Although most of the water is used to irrigate its own lands, the company controls sixteen subsidiary canal companies. Water is supplied at the rate of 75 cents per cubic foot per second, flowing for 24 hours—equivalent to 37.5 cents per acre foot.

The San Joaquin and Kings River Canal and Irrigation Company diverts water from the San Joaquin River for the irrigation of about 100,000 acres on the west side of the San Joaquin Valley in Fresno, Merced and Stanislaus Counties. The water rate has been fixed by the Boards of Supervisors as follows:

Stanislaus County	$2.35	per cu. ft. per sec. for 24 hrs.
Merced County	1.90	" " " " " " " "
Fresno County	1.25	" " " " " " " "

The Pacific Gas & Electric Company owns and operates a number of canals diverting water from the

Yuba and Bear Rivers in Placer County. The canals were formerly used for hydraulic mining but are now used for irrigation and municipal supply. No water rights are sold but the rates for the various kinds of service are fixed annually by the County Supervisors.

Examples of Companies Selling Water Rights But No Interest in System.

The San Diego Land and Town Company owns the Sweetwater reservoir and canal system in San Diego County. It has sold land under its system with and without a water right, has sold water rights to other lands, and has furnished water on a rental basis to lands having no water right.

The California Development Company diverts water from the Colorado River for the irrigation of about 225,000 acres in the Imperial Valley. It has contracted with several mutual companies to supply water at the rate of 50 cents per acre foot—4 acre feet being sufficient for one acre. The mutual companies sell water rights on the basis of one share of stock to the acre, at the rate of $15 to $25 per acre, which amounts must be paid to the California Development Company. The water user pays an additional sum of about 20 cents per acre to the mutual companies for maintenance and operation.

The Fresno Canal & Irrigation Company and the Consolidated Canal Company are under the same management and divert water from the Kings River for the irrigation of about 360,000 acres in Fresno County. Water rights are sold at the rate of $10 per acre for first class rights under the Fresno Canal and Irrigation system and $5 per acre for second class rights under that system and rights under the Consolidated. The rights are on the basis of one cubic foot per second to 160 ocres. There is an additional annual charge of 62.5 cents per acre under the Fresno and 75 cents per acre under the Consolidated.

The Crocker-Huffman Land & Water Company diverts water from the Merced River for the irrigation of about 60,000 acres in the vicinity of Merced. Water rights on the basis of one cubic foot for 160 acres, are sold at the rate of $10 per acre, with an additional annual maintenance charge of $1 per acre.

Examples of Companies Selling Water Rights Carrying an Interest in System.

The Patterson Land Company diverts water from the San Joaquin River for the irrigation of 19,000 acres on the "West Side" in Stanislaus County—all owned by the company. The irrigation system has been transferred to the Patterson Water Company. Water rights on the basis of 2 to 3 acre-feet per acre are sold with the land at prices from $200 to $500 per acre. An additional annual charge of $3 for 2 acre feet and $1.50 for the extra acre foot is made. A share of stock in the water company is given with each acre sold, but the land company will retain management until 75 per cent of the land is sold, after which the land purchasers will be given control.

The Sacramento Valley Irrigation Company has purchased the old Central Canal and is extending the canal and lateral system to cover about 150,000 acres on the "West Side" in Glenn and Colusa Counties. The company is a land company and is purchasing all the irrigable land under the line of canal which it can secure. The Sacramento West Side Irrigation Company has been formed to operate the system. Water rights on the basis of 1½ acre feet per acre will be sold with the land at prices from $125 per acre upwards. An additional annual operation and maintenance charge will be made. A share of stock in the West Side Company will be given with each acre of land, so that the land purchasers will ultimately operate and manage the system.

Most of the larger mutual companies in southern California were started as commercial enterprises of this group. There is probably no better example than the Gage Canal which is known as one of the most highly developed systems in the country. It diverts water from the Santa Ana River for the irrigation of about 10,000 acres near Riverside. The Riverside Trust Company originally owned the land and canal system. Each acre sold carried a water right of one-fifth of an inch and two shares in the Gage Company.

The Colorado Anti-Royalty Act.

In the early eighties a number of canal systems were built in Colorado which sold water rights and also charged an annual rate. This custom was stopped by the so-called Anti-Royalty Act of 1887, which made it unlawful for a ditch owner to accept payment corresponding to that for our right before supplying water at the annual rate. To evade the provision of the Act water rights were sold providing that when water rights amounting to the estimated capacity of the canal were sold, the company would transfer the system to a new company formed exclusively of water users. In the early days the estimated capacity was placed so high that it did not become necessary to form the new company and relinquish the works. In more recent years, however, such contracts have been executed and the capacity fixed by the company in good faith and have been extensively used, not only in Colorado but in Nebraska and Oregon also.

The Regulation of Commercial Enterprises.

At an early date statutes were passed in a number of the western states authorizing the county supervisors, or commissioners, to fix the rate at which commercial enterprises should furnish water to irrigators. (The statutes of the last session in some of the states transfer this power to the railroad or public service commissioner.) In the absence of such rate fixing the rates established by the water company controlled. The state and federal courts in California have vacillated in their determination as to whether rates agreed upon in formal water right contracts, executed prior to the rate fixing by the county board, should be enforced after lower rates had been fixed by such board. On March 2, 1897, the California legislature amended the act providing for such regulation by adding a new section expressly stating that nothing in the original act shall be construed to "invalidate any contract already made." The new section was interpreted by the California Supreme Court in Stanislaus Water Company v. Bachman (152 Cal. 716), wherein it was held, "And under the present statute the contract rights prevail in all cases, the boards of supervisors being powerless to effect or interfere with them."

In the more recent case of Leavitt v. Lassen Irri-

gation Company (157 Cal. 82) decided December 24, 1909, the Supreme Court said:

The language of this court in Stanislaus Water Company v. Bachman * * * must be construed in the light of the facts there presented. * * * *

If it be conceived that Section 552 Civil Code, is designed to confer upon any particular consumer any special, permanent, and preferential right above what is here stated, that effort, being plainly violative of the Constitution, would be held void. The same declaration applies to the provisions of the act entitled * * * * approved March 12, 1889, and of the amendment of that act by the act approved May 2, 1897.

The Leavitt case deals with a prior and perpetual water right reserved by the former owner (the plaintiff) in selling a commercial enterprise to the company (defendant). It seems that such an exclusive and preferential right could be easily distinguished from the ordinary water right provided for in the amendment of 1897, but as so many capable attorneys hold to the contrary it would be unwise to organize an irrigation company with the idea of establishing by contract profitable rates which could not be lowered by the county supervisors.

Who Owns the Water Right.

The expression "selling water" is so commonly used that few laymen ever doubt that the irrigation company is the owner of the water right and that, in selling its system or in rate fixing, it is entitled to a considerable sum for such right. It is surprising to most, therefore, to learn that the Supreme Court of Colorado, so long ago as 1887, in Wheeler v Northern Colorado Irrigation Company (17 Pac. 487) said:

It (the irrigation company) exists largely for the benefit of others; being engaged in the business of transporting, for hire, water owned by the public to the people owning the right to its use.

The question was not a direct issue in California until the recent case of San Joaquin & Kings River Canal and Irrigation Company v. Stanislaus County (191 Fed. 875) decided September 18, 1911. The company had brought suit against the county to enjoin the enforcement of water rates fixed by the County Supervisors. One of its contentions was that its water rights were worth $1,000,000, and that nothing had been allowed for them in the Supervisors' valuation. After a careful consideration of the authorities, Judge Morrow refused to accept the contention in the following words:

The claim, as stated, is manifestly not sufficient to state a right of diversion. It must appear, further, that the complainant is either the owner of land for which the water is being appropriated for a beneficial use, or that the water is being diverted for the purpose of being carried by the complainant to consumers who own land for which the water is being appropriated for a beneficial use, and that the water is being so used. The complainant in this case is not the owner of any land for which the water is being appropriated. The complainant's right to divert the water of the river is therefore based upon and is measured and limited by the beneficial use of certain consumers for which the water is being appropriated. But, if the amount required by these consumers for a beneficial use is not 1350 cubic feet of water per second, then complainant has no right to divert that quantity of water; or if, for example, these consumers require only 100 cubic feet per second for beneficial use, then that would be the basis and measure and limit of complainant's right to divert water from the river, and not the capacity of complainant's headworks, canals and ditches used in making such diversion. The water right must, therefore, be the right of the consumer and attached to his land, and not the right of the complainant attached to its canal system.

The irrigation company has appealed to the Circuit Court of Appeals and the case will probably be carried to the Supreme Court of the United States. The reader is referred to the opinion as an excellent exposition of the principles underlying not only the question of ownership of water rights but also the many other questions regarding rate fixing for public utilities.

As the cases now stand the Supreme Courts of Arizona, Colorado and Nebraska and the U. S. Circuit Court in California positively hold that the water right belongs to the user and not to the irrigation company. The only Supreme Court indicating to the contrary is that of Montana in Bailey v. Tintinger (122 Pac. 575) decided March 5, 1912. The case was simply one to determine the relative rights of a number of ditch owners and the Court, instead of applying the accepted rule that every appropriator must be given a reasonable time after the completion of the ditch in which to apply the water to beneficial use, holds that under the Montana statutes the appropriation must be considered complete upon the completion of the ditch. In the course of its opinion the court says:

To deny the right of a public service corporation to make an appropriation independently of its users or future customers * * * would be to discourage the formation of such corporations and greatly retard the reclamation of arid lands in localities where the magnitude of the undertaking is too great for individual enterprise.

In view of the issue before the court the above expression should be considered a dictum only. It is another illustration of the dire need of rational water right legislation in Montana.

A further statement of the present and future status of commercial irrigation enterprises will be made in a later article after the discussion of other types of irrigation enterprises.

STREET RAILWAY PRACTICES IN GERMANY.

By Vice Consul General We Witt C. Poole, Jr., Berlin

I am reliably informed that no assessment of the cost of street railway extensions on the property supposed to be benefited thereby is made in Berlin. Real estate development interests not infrequently approach the local street railway companies on the subject of extensions into the locality which it is desired to develop. In these cases the street railway companies usually demand a guaranty of earnings for a limited period, contracting sometimes for compensation in accordance with transportation facilities offered. Thirty-five pfennigs (8 1-3 cents) per car-kilometer (kilometer = 0.62 mile) is a rate of compensation frequently agreed upon. These are, however, purely voluntary arrangements.

It is usual in Germany for street railway companies to pay a certain portion of their gross earnings to the municipality within the jurisdiction of which they operate. In Berlin the portion is at present 8 per cent. The franchise is in the nature of a contract, and the city stipulates for an option to take over the entire street railway property at a prearranged price on the expiration of the franchise.

DRAFTING ROOM PRACTICE, V.

BY A. L. MENZIN.

Drawing Details.

Fig. 1 shows the practice of a large American firm in the detailing of structural steelwork. Instead of placing the dimensions between arrow-heads, as is customary, the dimensions are placed above the dimension lines. Fractions are written without the intervening line and inch marks are omitted where no uncertainty can result from the omission. Side views of rivets are not shown. Open holes and the different kinds of rivet heads are indicated by employing the conventional signs given in handbooks of the manufacturers of structural steel. Thus in Fig. 1, the rivets in the column footing are to have countersunk and chipped heads on the bottom face. All other heads are to be full. Certain holes in the angle connections at the top of the column are to be left open for field work. The practice illustrated in this drawing is conducive to great clearness and permits of very rapid detailing.

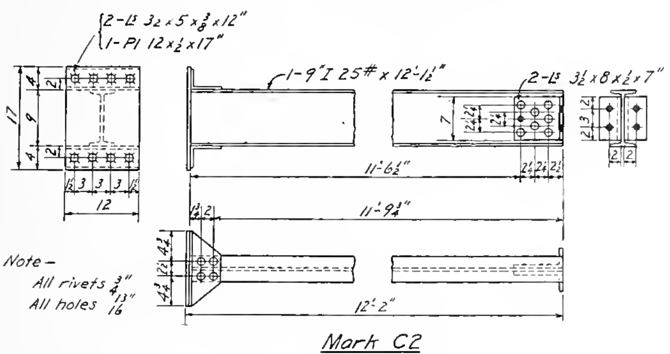


Fig. 1. Structural Steel Work Detail.

The making of piping drawings is another class of work in which conventional representations may be used to advantage. The outline drawings of valves and screwed fittings given in catalogues of the manufacturers contain too many lines to be suitable for ordinary working drawings. The outline drawings for flanged fittings are very simple and are usually copied as given. Simplified drawings of valves and screwed fittings suitable for working drawings are given in Fig. 2.

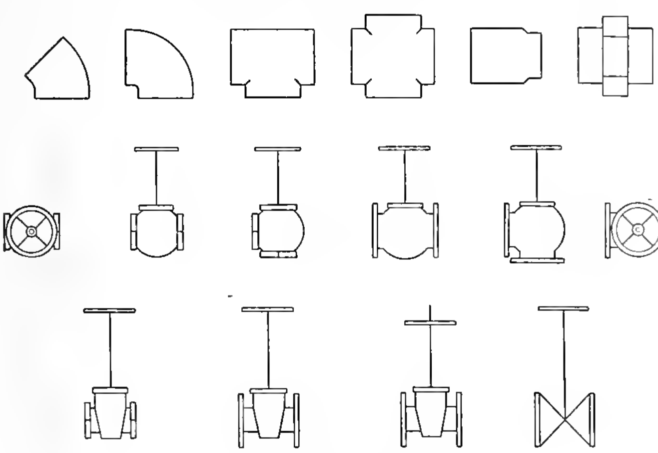


Fig. 2. Valves and Screwed Fittings.

The drawings in the upper row, with the exception of the last, which represents a screwed union, are imitations of plain gas fittings, but may be used to represent beaded fittings as well, since specifications for the particular kind of fittings to be furnished are usually given on the drawing or elsewhere.

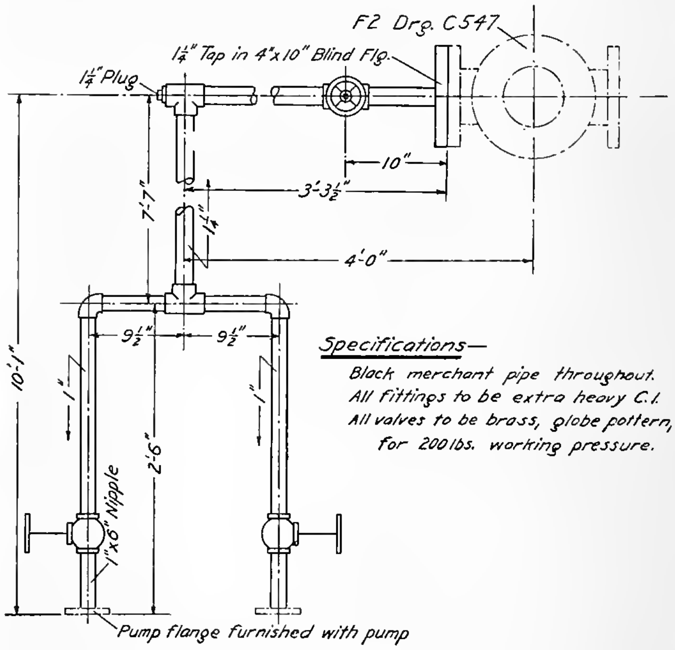


Fig. 3. Flange Piping Details.

The drawings for the valves are self-explanatory, with the exception of the last two in the bottom row. The next to the last drawing indicates a gate valve with a rising stem. The last drawing shows a way of representing both gate and globe valves in common use.

Fig. 3 shows the detailing of flanged piping. In this class of work the dimensions given are from center to face of fittings and angle valves, and from face to face of opposite flanges on straight pipe. Face to face dimensions of globe and gate valves are also given. To facilitate erection, marks for each individual piece are shown. Parts of the same kind and size should bear the same mark, since this practice simplifies the bill of materials and also saves the erector unnecessary work.

It is often desirable, to avoid drawing auxiliary views, to show a piping lay-out in a single view. This may be done by imagining certain parts to be rotated so that all of the piping will lie in the same plane. Thus in Fig. 3, the bends P7 and P8, have been rotated 90 degrees to bring them in the same plane with the other piping. A correct arrangement of the piping should be shown on the general assembly drawing, or else notes should be placed on piping out of position to indicate how it is to be erected.

Detailed drawings of screwed piping, such as Fig. 4, show center to center dimensions for all valves and fittings, or else the lengths of connecting nipples are given.

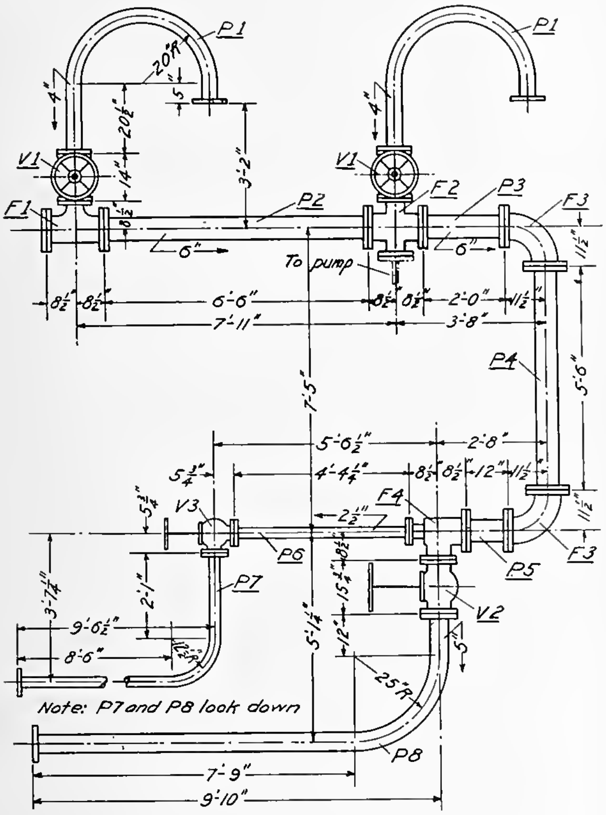


Fig. 4. Piping Conventions.

Fig. 4 also shows one way of indicating the connection between piping shown on different drawings. The relation between the piping shown in Fig. 3 with that shown in Fig. 4 is indicated in Fig. 4 by reproducing the fitting F2 in phantom lines and giving its mark and drawing number.

ELECTRICAL INSTRUMENTS IN ENGLAND.

American tourists have long wondered at the popularity of the tumbler switch for turning on and off the lights in rooms of English hotels. That Englishmen visiting America have assumed the same attitude toward our push-button switches is asserted in a monograph on English electrical instruments just issued by the Bureau of Manufactures at Washington, as a result of investigations by H. B. Brooks, commercial agent of the Department of Commerce and Labor. The relative merits of the two systems is discussed in the pamphlet, and several arguments in favor of the American device are put forward.

In the same bulletin it is asserted that English girls have failed to give satisfaction at such work as winding coils and calibrating instruments. The English manufacturer is of the opinion that the girls do well at light routine work, but are content to go on year after year performing the same tasks. For example, a girl may be taught to calibrate 100-ampere ammeters, and will do well on a lot of these, but if she is to do such instruments one day, and another sort the next, and so on, she requires too much superintendence.

In one of the largest electrical works in England the time-limit system is used in the testing room. Thus, if eight hours is the alloted time for a particular piece of work and a man does it in six, he is paid for one of the hours saved and the firm saves the other. In this shop the average instrument worker earns sixteen to eighteen cents an hour, while some of the highest class men make twenty to twenty-four cents. The works of seven of the leading electrical firms in England are dealt with in the same publication.

ELECTRICAL APPLIANCES IN THE HOME.

The Wall-street Journal recently commented editorially on the exploitation of electrical appliances in the home. Our own views may be found on the editorial page, while the editorial matter referred to is as follows:

Electrical manufacturing companies are spending much money at the present time in advertising household appliances and luxuries. This is an increasingly promising policy and is resulting in a considerable growth of business. Sales of electrical conveniences for the home are running 40 per cent higher this year than last. Factories are busy turning out irons, toasters, water heaters, hair curlers and the many little luxuries of life, while new manufacturing facilities are being planned. The effect upon the earnings of producing companies will soon begin to show in annual reports.

Another campaign, secondary to advertising, would be well worth the consideration of manufacturing concerns. This is to establish cheaper rates for domestic consumers. No one who has looked into the matter at all would deny the advantages of electrical appliances in the house. Nor is it the cost of the utensils that retards their wider use. It is the high cost of operation that causes hesitation. With current selling at 10 cents per kilowatt, it costs about 4 cents an hour to use an electric iron. Toasters and cooking devices cost even more. The would-be user of moderate means is appalled by the expense. The chief of the household department of one of the largest manufacturing companies once sized up the expense: "Any man who can afford to maintain a high-powered touring car can afford to cook by electricity." To a large percentage of the population this means prohibition.

If the manufacturing companies would really give a boost to the use of these conveniences, let them enter the campaign to reduce the charge for current to something like a reasonable comparison with the cost of manufacture. When energy can be made for less than one cent, it is demanding an undue profit to charge the consumer ten cents. The great manufacturing concerns, which are financially interested in many of the light and power companies, could force a reduction if they took up the campaign in earnest.

Such reductions would benefit all concerned. The sale of appliances would be multiplied; the citizen would have more sanitary, cleanly and satisfactory service, and the generating company would have an increase in consumption and a distribution of load that would swell rather than curtail net profits. If manufacturers really want to increase sales, let them consider this method of adding to the circle of possible users. There is no better way to create a market.

REPORT OF THE N. E. L. A. RATE RESEARCH COMMITTEE.

General.

The great necessity of adopting as rapidly as possible, uniform methods of charging for central-station service has already been pointed out. It is not alone sufficient that some general policy of rate making be recognized by the several companies, but it is very desirable that the actual form in which the rates are placed before the public should be as nearly alike as possible.

The committee believes that retail rates quoted in schedules may be gross rates, subject to a moderate cash discount for payment within fifteen days or less from date of bill. Giving half the cash discount during the succeeding ten days has been adopted by some companies and found to expedite collections and promote friendly relations with the consumer.

The specific recommendations of the committee regarding forms of rates to be considered for the several distinct classes of customers are given herewith.

Customers of Large Size.

The committee agrees unanimously in recommending that all large customers be charged on a schedule making separate and distinct demand and energy charges. The unit charges per kilowatt of annual maximum demand and per kilowatt-hour consumed may be made to decrease respectively with an increase in the number of units of annual maximum demand, and the number of units of energy consumed monthly, according to a block system, applying to both the demand and energy charges. By allowing the unit charges to decrease in this way the equivalent of a customer charge is worked into the rate schedule.

Feature Rates.

The committee believes that for storage battery charging, for refrigeration and for other similar classes of business still lower rates can properly be made, for which separate schedules may be desirable.

Lamp Renewals.

The committee believes that it is for the best interest of central stations and the public that the rate for electricity should be such as to permit the free renewal of standard lamps and the offering of other lamps at such low prices as to prevent dealers from competing with inferior lamps; or, if this policy is not adopted, the offering of lamps only at such prices as to encourage dealers to compete with a good quality of lamp.

Minima.

There should be an appropriate minimum charge per customer. There should be a minimum charge per kilowatt for auxiliary or break-down service. There should be a guarantee of income in contracts which require extensions to plant or lines and which might otherwise be unprofitable.

Subject to these minima, the company should have for ordinary conditions a maximum rate per kilowatt-hour.

Modification Necessary for Small Consumers.

Differences of opinion exist in regard to the modifications that should be introduced when the size of the customer to whom the demand rate for large customers applies decreases to a certain limit, the value of which is also open to discussion. The line of demarcation between large and small consumers should be drawn somewhere between $50 and $200 per month for light, and somewhere between $10 and $100 per month for power. While it is entirely possible to measure both the maximum demand and the energy consumed in the case of large consumers, it is obviously impracticable at present to go into such refinements in the case of smaller consumers, and, as a consequence, certain approximations must be made in fixing the cost of service to the small consumer, which in turn require some average condition to be recognized as a basis for calculation. To just what extent it is desirable or necessary to average the conditions under which service is rendered to the small consumer is the point upon which the committee has been unable to agree.

Modification—Using a Single Rate for Small Consumers.

On the one hand, all customers less than a certain size may be averaged in one large group regardless of load-factor, and a kilowatt-hour rate applied to all alike, the only differential recognized being one based entirely upon the quantity of energy used. This method of treatment leads to the adoption of a block rate embodying kilowatt-hour charges only for all consumers not previously considered as large customers. The reduction in kilowatt-hour rate to customers using fairly large quantities of energy has the effect of introducing into their bills the equivalent of a customer charge. The general level of the kilowatt-hour charges in this rate would, of course, be higher than in the case of the rate for large consumers, in order to cover the demand and customer charges involved in rendering service to the average small consumer. This rate should carry with it a suitable form of minimum. The first step in such a block rate could include so many kilowatt-hours that the average residential consumer would receive his entire energy-supply at a straight-line meter rate, thus presenting to him an extremely simple rate and one that he can readily understand. As this rate gives to all small consumers, both residential and commercial, a charge based entirely on a quantity of energy consumed each month larger than the average residential customer is likely to use, it does not offer him a very great incentive to adopt any of the electrical devices which add so greatly to the convenience and utility of electric service.

Modification—Using a Two-Charge Rate for Small Consumers.

The desirability of more strongly encouraging long-hour use of service has led, on the other hand, to the recognition of a rate which will give even the smallest consumer the advantage of a decreasing unit-charge for energy with increasing load-factor. To accomplish this a two-charge system which recognizes the demand and the energy consumption as independent elements in the cost of service is required, as in the case of the large consumer. Under such a system the small customer receives a like benefit of

long-hour use of his service, even where the quantity of energy consumed would of itself not warrant a reduction in his unit-charge under the block kilowatt-hour rate.

Form of Two-Charge Rate for Small Commercial Consumers.

In order that a customer may receive some benefit from the long-hour use of his service, a differential rate must be established involving the elements of both demand and energy consumption. In the case of small commercial consumers, a majority of the Committee recommend that a method of charging apply as indicated in the schedule of rates shown on Sheet 2, with the understanding that the electrical demand (always measured in the case of the large consumer) may be estimated, if desired, for the small commercial installations on the basis of connected load. It is believed that even the smallest commercial installation would accept a rate, making separate demand and energy charges, without question, and as such a rate is the simplest form of a two-charge rate it is recommended for adoption wherever possible.

Demand Element in Two-Charge Rate for Small Consumers.

While it is believed by many that the actual measured electrical demand of the small consumer is the theoretically correct demand basis of a two-charge rate, and that it will ultimately prove to be the general basis used, there are certain reasons why such an electrical basis of demand rating cannot be adopted exclusively for commercial use at the present time.

First.—There is at the present moment no reliable device on the market for measuring electrical demand generally at a cost sufficiently low to admit of its application to consumers of small size.

Second.—In residential service, the lighting demand constitutes at present the greatest average demand, but it by no means represents the greatest individual maximum demand, taking into account the use of heating and cooking devices and other power applications. However, the diversity-factor applying to the use of such apparatus is so great at present that it is not deemed wise to adjust the demand charges, properly determined by the lighting load, on a basis which would at this time include other applications of service. When these other applications become of more than incidental importance in affecting the demand of any individual group of customers, they should properly be considered in establishing the electrical demand as a basis for rates. Until that time arrives the fact that the heating and cooking devices are used on the customer's lighting circuits makes it impracticable to separately measure or control the lighting demand without also bringing the heating and cooking demand into consideration, which, as just pointed out, is not a desirable thing to do at present.

Form of Two-Charge Rate for Residential Consumers.

In the case of residential service, it is not considered advisable to attempt to make separate and distinct demand and energy charges, for, to the residential consumer, whose use of service may vary greatly from month to month, a fixed monthly demand or "service charge," as he regards it, appears very burdensome and unjust. In order to overcome this objectionable feature it is recommended that a rate involving the use of a certain amount of energy, as explained later, at a primary rate per kilowatt-hour each month before a lower secondary rate applies, and embodying a suitable minimum, be adopted for residential service.

Two-Charge Rate for Residential Consumers.

Under the form of a two-charge rate recommended for residence business, the customer pays for a certain number of kilowatt-hours consumed each month at a primary rate, and for all kilowatt-hours in excess of this quantity at a lower or secondary rate. In some cases a still lower tertiary rate is applied to all energy consumed in excess of the amount required at a primary and secondary rate. The number of kilowatt-hours that must be consumed at each higher rate before the next lower rate applies ordinarily depends upon the customer's demand. By making the number of units to be used at the primary rate equal to a constant plus some function of the consumer's demand, or by decreasing the number of hours' use of demand at the primary rate as the demand increases, the equivalent of a customer charge is embodied in the schedule. The action of this rate is obvious. The fixed charges are covered by the difference between the low final rate and the primary rate which applies to the predetermined quantity of energy used at the primary rate.

Minimum Demand in Two-Charge Rate for Small Consumers.

While the demand for small consumers should be based primarily on electrical demand, there are excellent reasons for establishing certain minimum values of demand for these consumers, depending, in the case of commercial service, on the connected load, and, in residential service, on the floor area or number of rooms. It is the understanding that in ordinary cases the demand as established by this minimum will be used in place of the measured electrical demand, thus not only saving a great deal of expense by eliminating measurement of the demand of the small customer, but at the same time assuring the station a minimum return from the small consumer which is to some degree fixed by the value of the service to him.

Lamp Efficiency and Minimum Demand.

A very important reason for establishing a minimum demand to apply to the small customer served on a two-charge system is involved with the efficiency with which energy is utilized in lighting. The efficiency of light production is unsettled, not only because changes are now being generally made by customers to the more efficient types of incandescent lamp, but also because lamps of lower wattage and higher efficiencies seem inevitable. Until the probable limit of development can be more fully predicted, or until the growth of other applications of service makes the lighting demand of incidental importance, the central-station's fixed service and demand charges must be protected by the rate schedule. It is obvious that the fixed charges of central stations would be reduced by any general and sudden decrease in the present electrical demand, which would simply leave a portion of the generating equipment idle, and as such a general

reduction is at least not beyond the bounds of probability as long as the lighting service retains its present importance; and the incandescent lamp seems capable of so much further improvement, it is advisable to provide a minimum below which the electrical demand shall not fall in the case of each consumer, such minimum being based on some approximate measure of the value of his lighting service. For residential customers, this general idea finds expression in rates involving the use of floor area or active rooms, as in Detroit, Milwaukee, St. Louis and Toronto.

Rate for Very Small Consumers.

In certain sections of the country local conditions indicate the necessity of providing an extremely cheap and simple method of serving consumers of very small size. Consumers whose maximum demand would fall between 100 and 300 watts could probably be charged on a pure demand rate, the demand being controlled by some form of current limiting device, several types of which are on the market. The customer under such a rate pays a fixed monthly charge per watt of maximum demand for which his controller is set. Theoretically the unit demand-charge should decrease with the size of the customer, in order to provide the equivalent of a customer charge (as in the rates for large users), but practically it is hardly necessary to go into such detail. Under such a rate the customer's bill is the same from month to month, which meets with his approval, the billing is simplified and the periodic reading of meters as well as a large part of the meter expense is eliminated.

Desirability of Having Controlled Flat Rate for Very Small Customers.

A demand rate for the very small consumer will generally serve to introduce electric service where it would otherwise remain unknown, and as the consumer grows in size or wishes to take advantage of heating and cooking devices he will naturally be transferred to rates that permit of their use. It must be distinctly remembered that, while there may be many localities where the need of such a rate is not felt, in many others it would prove profitable. The Committee, in attempting to make its report of widest and most general use,has of necessity adopted several viewpoints and endeavored to recommend as few rates as possible to cover the fundamentally different local conditions which it recognizes as existing.

CONSUMER.	TYPE OF RATE RECOMMENDED	
Large Consumers, Lighting and Power.	A block rate making separate demand and energy charges.	
	Either	or
Small Consumers, Commercial, Lighting and Power.	A block rate making separate demand and energy charges.	A straight line or block rate carrying kw. - hrs. charges only.
	Based on electrical demand with a minimum demand.	Suitable minimum.
	Either	and/or
Small Consumers, Residential.	A two-charge rate based on demand, with a minimum demand estimated on a floor area or room basis.	A straight line or block rate carrying kw. - hrs. charges only. Suitable minimum.
or Very Small Residences.	A demand - rate based on controlled or limited demand.	———

STRENGTH OF CROSS-ARMS.

An interesting investigation on the strength of cross-arms has just been completed by the Forest Service, the details of which are given in Circular No. 204:

Cross-arms must resist forces which are variable in amount and direction. In a line the arms may be subjected to heavy loads under several conditions:

(1) If the wires on one side of a pole are broken, a heavy side pull comes on the cross-arm from the other side. This causes a severe stress in the pole, and, as will be shown later, the pole is more likely to be broken than the cross-arm.

(2) If the wires are heavily covered with sleet and there is a strong wind blowing, there is a pressure on the cross-arms, but here again the stress in the pole will cause it to fall before the cross-arm will give way. Similarly, in changes of direction in the line the sidewise pull of the wires is more severe on the poles than on the arms.

(3) If the cross-arms are at the same level in the line, they can receive no greater strains than those which may be imposed by the weight of the wires, and of adhering ice, and by wind pressure. If, however, the middle pole of three is higher than the poles on either side and the wires are tightly stretched, there is a strong downward pull on the cross-arms. A similar condition might result if a single pole were left standing in a line where the pole on either side had fallen.

The average load borne by the Southern white cedar cross-arms, the weakest group, was 5000 pounds, the load being applied vertically. By careful estimate the resistance of these arms to side pull is at least 4000 pounds. Under any conditions of service this is more than sufficient, because it is so much greater than the side load that can be sustained by poles. In tests these have not withstood an average side pull of much more than 3000 pounds, and usually have failed at less than 2000. Further, both the pole and cross-arm tests were made on air-dry material, while under actual conditions of use the poles would be weakened by moisture much more than the cross-arms.

In the case of sleet or snow, if the ice coating on the wires gives each strand a diameter of 1 inch, a wind pressure of 27 pounds per square foot would be sufficient to break the pole, assuming that the poles have a resistance to side pressure of 2000 pounds, and are 150 feet apart. Even under these extreme conditions the cross-arm would have to resist stresses equivalent to those imposed by a load of only 875 pounds, applied as in the tests, so that even the weakest of the arms tested would have more than sufficient strength to withstand a force which would break the average pole.

Where there are abrupt changes of grade in a line, as in the case of one pole higher than those adjacent on either side, the downward pull on the cross-arm depends on the stress of the wires and their inclination from the horizontal. If 6 No. 8 wires are stretched to their maximum strength, assumed to be 60,000 pounds per square inch, they can exert a pull of 7670 pounds. If a cross-arm on the middle pole had the average strength of Southern white cedar, it could not be broken by such a pull unless the pole were at least 45 feet higher than the two at each side, the spans being

150 feet. Such an abrupt change in grade is rare in practice. If the cross-arm were weakened to 60 per cent of its air-dry strength, which would correspond to a green or water-soaked condition, the arm would not break unless the difference in height were at least 25 feet.

All things considered, cross-arms of the species and dimensions tested are strong enough for ordinary use; with longer arms the strength is relatively of much more importance. With the standard 6-foot cross-arm, however, the question of strength need not enter into caluculations of line construction, except in the rare case of abrupt change in grade. The ability of the timber to resist decay, and methods of preventing decay, are considerations of greater importance.

TUNGSTEN AND ITS USES.

The rapid rise of the tungsten lamp makes a resume of the great industry brought to life of timely interest. E. C. Voorheis, a mining operator of Sutter Creek, California, in a recent issue of the Pacific Gas and Electric Magazine, writes regarding tungsten as follows:

California produces a great variety of minerals, including gold, diamonds and other gems, but of all the various minerals and ores which occur in the Golden State none are of greater interest than the ores of tungsten.

Tungsten has long been known to mineralogists, but the layman has only become familiar with it within recent years. It is a metallic element. It does not, however, occur in a free state, but always in combination with some mineral substance. It is found in combination with oxygen as tungstite; with calcium as sheelite; with iron as ferberite; with manganese as hubnerite, and with iron and manganese as wolframite.

Tungstite occurs only in very small quantities, usually being found in traces with the outcrops of bodies of other ores.

Scheelite is a tungstate of calcium (lime), and is one of the rarer ores. It is found mixed with the ores of bismuth, molybdenum and antimony in Australia, and, in small quantities, in other places. California enjoys the distinction of having a deposit of this ore which is unassociated with other metals, and for this reason is in great demand and is called standard quality of tungsten ore.

Ferberite is a tunstate of iron and is the form in which most of the tungsten in Colorado is obtained.

Hubnerite is a tunstate of manganese and occurs in scattered bunches throughout the Western States. It is not produced in any great quantities.

Wolframite is a tungstate of iron and manganese and varies in composition between ferberite and hubnerite. It is the most commonly known ore of tungsten.

These ores differ in appearance. Wolframite and hubnerite are dark brown to nearly black, while scheelite is white or grayish white to yellowish, some times dark gray. The chief physical property of these several ores is their great density, their unusual weight always attracting the attention of anyone who chances to find a piece while prospecting. The first two—that is, wolframite and hubnerite—are often mistaken for iron ore, but no iron ore is as heavy as either of the ores of tungsten when pure. Of the three, wolframite is the heaviest, having a specific gravity (density) of 7.2 to 7.5, whereas that of metallic iron is but 7.3, and that of hemantite 4.9 to 5.3. Hubnerite has a density of about 5, and scheelite 5.9 to 6.1. Thus, it will be seen that the tungsten minerals are all of unusual weight for their bulk, as compared with other common minerals, such as quartz which has a density of only 2.65.

Tungsten ore is mined and shipped from a great many countries, but the principal supply comes from Queensland, Portugal, Argentina and the United States. The ore is not uncommon, though tungsten is known as one of the rare metals. Deposits that can be worked at a profit, however, are very unusual. The ore almost without exception occurs in such rocks as granite, and even then under conditions which indicate that its deposition has been due to exceptionally high temperature and great pressure.

Dr. W. R. Whitney, of the General Electric Company, estimates that the saving to the consumer in the introduction of tungsten lamps is about $240,000,000 per annum.

The following is from Consul-General Robert F. Skinner, Hamburg, Germany:

Incandescent Lamp Filaments.

"'The metallic wolfram, or tungsten, used in the form of threads in incandescent lamps, is obtained from wolframate. Wolfram acid (wolfram trioxide WO_3) is imported into the United States for the manufacture of these threads. WO_3 is obtained from wolframate by heating together finely ground wolframate and HCl (hydrochloric acid); thus oxide of wolfram and soluble chlorides of Fe (iron) and Mn (manganese) are formed. The three products are carefully washed about a dozen times with water. They are then allowed to precipitate, when the water is again drawn off and fresh water added. The precipitate of wolfram oxide is dissolved in ammonia, whereby ammonium wolframite is obtained. This is filtered and heated and finally boiled together with HNO_3 (nitric acid) to remove the iron and manganese.

"Another method for the production of colloidal wolfram is to send an electric current under water through two electrodes made of metallic wolfram. In this way, small particles of wolfram are thrown off from the electrodes and form colloidal wolfram. The products of the three methods are of equal value. The wolfram thread coming out of the matrix is dried in an oven and then heated in an electric oven up to 2000 degrees C. to drive out the volatile ingredients. Then an electric current is allowed to pass through the thread in an atmosphere of indifferent gas, and the thread for the lamps is thus obtained.

"The current consumption of the wolfram lamp is from 1 to 1.3 watts per Hefner candlepower, whereas the carbon-thread lamp consumes 2.3. The disadvantages are higher prices and greater fragility of the thread. Against this, the wolfram thread has a longer life (1000 burning hours against 450 of the carbon thread lamp), and it is also much less sensitive to current fluctuations. The wolfram light also gives a better light."

JOURNAL OF ELECTRICITY
POWER AND GAS

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NOTICE TO ADVERTISERS.
Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895
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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Electrical Appliances in the Home

No one for a moment questions the advisability of a clean-cut campaign for an increased use of electrical appliances in the home. The recent advent of the tungsten lamp, making possible the lighting of the home for far less outlay per month than formerly, necessitates new and increasing demands for power consumption by developing new applications of electric power. And, indeed, this campaign has been consistently carried on both by the manufacturer and the central station. As set forth on another page, this campaign has resulted in the sales of electrical appliances for the home showing an increase of 40 per cent during the past year.

Undoubtedly in many cases power companies could well afford to lower their rates in the effort to increase or encourage new cooking devices, which are beyond the reach of application for the average man at present, due to the non-economy resulting. It is unfortunate, however, that the writer of the article referred to, should use the misleading argument that since electrical energy can be made for less than one cent, it is demanding an undue profit to charge the consumer ten cents. Such statements as this, misleading in their character regarding public utility costs, get into the hands of the agitation-loving politician. The uninformed jump to the conclusion at once that a gigantic profit of nine cents per kilowatt-hour is being made from an outlay of one cent.

Let us for a minute analyze some of the evidence brought out in the hearing of the controversy between the Great Western Power Company and the Pacific Gas and Electric Company. It is, indeed, true that the evidence showed that power is being generated by the Pacific Gas and Electric Company, the largest hydroelectric distribution system in the world, for less than one cent. In fact, six mills is the total cost of hydroelectric power to substation without counting depreciation. Taking into account the necessary steam auxiliary service, this cost is brought up to 1.06 cents per kw.-hr. The cost of distribution, however, amounts to .505 cents per kw.-hr., and charges for depreciation and administration total 1.371 cent per kw.-hr., thus making a total of 2.936 cents per kw.-hr. The above constitutes the cost of service without profit of any nature and represents the economic results attained from a distribution so extensive that it can take advantage of every economic saving. In the city of San Francisco, where underground cables and conduits are largely required, the cost proved to be a trifle under 4 cents per kw. hr.

The economic law of cost of service is the final and equitable basis of rates. For residence distribution, the network of small meters and transformers runs the cost up much higher. Hence we condemn the misleading statement of power being generated for less than one cent as being in any way comparable to pass on the question of reasonableness of rates.

The central stations should do every reasonable thing within their power to encourage the use of electrical appliances in the home. In those States which have regulating commissions, however, where rates are scientifically based upon cost of service, it is questionable whether any material reduction would be wise. An equitable establishment of rates on the basis

of the report of the rate research committee for the N. E. L. A., an abstract of which appears elsewhere in this issue, wisely encourages larger consumption of power. This basis, founded on the fundamental economic law, will unquestionably encourage more and more the consumption of electrical energy in the home.

Irrigation by Electric Pumping Plant

In the Journal of March 2, 1912, appeared valuable data and illustrations relative to the installation of small electric pumping plants. About 25,000 horsepower of installed capacity for this purpose is now represented in the load of the Pacific Gas & Electric Company in the great central basin of California. The Southern California Edison has a load of similar gigantic proportions. Hence it is seen at a glance that the subject of pumping by electrical means is one of no small importance to western hydroelectric enterprise. Indeed when we stop to consider that in the territory now being occupied by the Great Western Power Company and the Pacific Gas & Electric Company, there are some 15,000,000 acres of arid land susceptible of successful irrigation by electrically driven pumps and that one horsepower of installed capacity is necessary for every ten acres to be irrigated, we stand aghast at the possibilities of such power consumption. As in the commercial world, when one dollar is set in motion by investment twenty more get active in allied industries, so in the irrigation enterprises, one horsepower installed for pumping leads inevitably to twenty more in caring for the enormous industries brought to life by the increased agricultural yield of a district of fertile productive soil.

It is, hence, little wonder that the subject of the use of electricity for irrigation and farming purposes was the most intensely interesting at the recent convention of the National Electric Light Association at Seattle.

An abstract of the leading paper on this subject given at the convention appeared in our last issue. In the early days of well pumping many feared that the ultimate extensive use of underground waters would tend to diminish the supply. Like the widow's cruse of oil, however, the water level seems not only to maintain itself at the original height, but in many cases the continued application of waters upon an arid section has actually raised this level much nearer the surface than formerly.

The paper on commercial irrigation enterprises by A. E. Chandler, appearing elsewhere in these columns, is instructive in comparing with the electrical pumping project detailed in our last issue. Much food for serious reflection is to be found in following up every phase of the gravity system with its various legal ramifications and that compared with the electric pump, which may be said in the parlance of the day, to be on the job day and night.

In the past many have hoped that pumping by electrically driven appartus could equal in cost the usual gravity system. Few dared to prophecy an economy could be realized in face to face competition with gravity supply. Those familiar with western irrigation projects know that forty to sixty dollars per acre is not an unusual outlay for a gravity system of supply. The former fails to figure in his costs anything else than actual outlay for maintenance. Interest and depreciation are unknown, meaningless symbols. In the case above referred to, the annual cost for water per acre for each season on the basis of 8 per cent interest on $47.20 per acre invested in the gravity system and bond interest of $1.68, together with $.40 for maintenance costs, the total of $5.85 per acre is found the result. On the other hand taking into account, interest and depreciation of the pumping station together with cost of electric power, the electrically operated system proves an expenditure of only $2.47 per acre per annum.

Such carefully compiled comparative data as this talks—and may the responsive vibration awakened be always the low hum of the busy motor aiding in reclamation of our great western empire.

What is the Correct Basis of Rates?

The mathematician endeavoring to figure out the fourth dimension is not in it with the rate specialist in his efforts to evolve a just and equitable rate schedule that takes into account all the variables and ramifications which enter into a consideration of this intricate subject.

The report of the N. E. L. A. rate research committee, marks a signal advance in establishing a uniform basis of rates. Some divergencies of opinion still exist as to the true basis upon which to build a just schedule of charges for the various classes of consumers. That system, however, which the more nearly brings about a charge for power in proportion to the actual cost of service demanded by each particular class of consumer is unquestionably the correct one. Such a system would neecssitate the consideration of at least one constant and three variable costs to meet Western conditions, as follows:

1. Cost of service depends upon a fixed rate of interest upon the entire investment plus that proportion of the cost of operation and depreciation which would be neecssary to maintain supply in readiness whether or no any of it is used.

2. Cost of service varies with the time of the day. A costly plant equipped to supply a peak for two hours each day certainly can encourage the utilization of power consumption in the "grave-yard" shift as is done in the pumping districts of the Southern Californio Edison Company at Long Beach and vicinity.

3. Cost of service varies with the season of the year. Hydroelectric power can be generated at a lower figure than steam power. Hence during the height of the hydroelectric supply power is certainly developed cheaper than at other periods.

4. Cost of service depends upon the place of distribution. The underground distribution of San Francisco, though situated in a congested district, nevertheless costs more than an overhead system in a city of moderate size such as Santa Rosa.

The California Railroad Commission has already shown originality and willingness to break away from eastern commission traditions. Their method of attack in the fixing of rates will be watched with the keenest interest.

PERSONALS.

W. H. Onken, Jr., an associate editor of the Electrical World, is a recent San Francisco visitor.

J. B. Lukes, representative of the Stone & Webster Engineering Corporation at San Francisco, is at Denver.

E. T. Jones, an electrical mechanician in the Government service, is a recent arrival from Washington, D. C.

R. D. Holabird, president of the Holabird-Reynolds Company, spent the past week at Lake Tahoe, with his family.

J. W. White, of the Vix Engineering Company, has returned to San Francisco from an extensive engineering trip.

C. P. Rhodin and **T. C. Gillespie** of J. G. White & Company's Pacific Coast organization, were at Los Angeles last week.

Ely C. Hutchinson of the Pelton Water Wheel Company's sales force has been spending a few days in the country.

Thomas Mirk, of Hunt, Mirk & Company, is in Southern California inspecting engineering work at Los Angeles and San Diego.

A. G. Wishon, general manager of the San Joaquin Electric Power Corporation, is a recent arrival at San Francisco from Fresno.

Wynn Meredith, of Sanderson & Porter's Pacific Coast office, will return to San Francisco next week after a trip through Mexico.

Jesse W. Churchill, one of the principal owners of the California-Oregon Power Company's system, is at San Francisco from Yreka.

Henry C. Ebert, president of the Cincinnati Car Company, who spent the past week at San Francisco, is visiting the Pacific Northwest.

C. W. McKillip, district manager for the Pacific Gas & Electric Company at Sacramento, is among the recent arrivals at San Francisco.

H. E. Warren, general superintendent of the Lombard Governor Company, is at Los Angeles on his way East after a tour of the Pacific Coast.

C. R. Ray, who has been connected for some years with electric power interests at Medford, is a recent arrival at San Francisco from Oregon.

Fred L. Webster, manager of the Allis-Chalmers Company on the Pacific Coast, has returned to San Francisco from a Southern California trip.

L. Henault, a French Government engineer in charge of roads, bridges and the canals of Paris, has been spending a few days at San Francisco.

Edwin Besuden, general sales agent of the Jewett Car Company, of Newark, Ohio, has left San Francisco for the East via Oregon and Washington.

Geo. J. Henry, Jr., hydraulic and mechanical engineer at San Francisco, is in Montana, investigating and reporting on a water power for the State.

S. N. Griffith of Fresno, Cal., who has been prominent in electric traction and oil interests, has returned to California after a tour of the Hawaiian Islands.

H. A. Everett of Willoughby, O., who has extensive electric railway interests, visited the Yosemite Valley with his party before returning to the Middle West.

J. D. Ross, superintendent of the municipal electric plant at Seattle, is visiting a number of eastern cities while returning from the national A. I. E. E. convention.

O. W. Lillard, manager of the Gould Storage Battery Company's Pacific Coast district office, has returned to San Francisco from Vancouver, B. C. His headquarters were recently removed to rooms 201-202 Rialto Building.

Count Philippe de Tristan, who represents French capital in the California-Oregon Power Company's board of directors, left during the past week on a business trip to Paris.

Chas. W. Baker, assistant engineer of the Westinghouse Machine Company, has returned to his headquarters at San Francisco after a business tour of the Pacific Coast.

Doctor Ernst J. Berg, a professor of electrical engineering at the University of Illinois, sailed on the Pacific liner Mongolia for Japan last week on a month's vacation trip.

R. J. Russell, president and general manager of the Century Electric Company, has been visiting the Pacific Coast cities since the close of the N. E. L. A. convention at Seattle. This week he will return to St. Louis from Los Angeles.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company of Chicago, has just returned from an automobile tour of Southern California, during the course of which he secured some very desirable orders.

F. G. Baum, consulting engineer, left San Francisco last Monday for a three months' tour of South America. Mr. Baum will visit the larger cities of Chile and Argentina, and will also make a trip to the headwaters of the Amazon river.

The monthly meeting of the twenty or more district managers of the Pacific Gas and Electric Company was held last week in the Pacific Building, San Francisco. **John A. Britton**, the general manager, delivered an address on the growth of the company's system.

E. K. Patton, western sales manager of the Bryant Electric Company and of the Perkins Electric Switch Manufacturing Company, is visiting the San Francisco branch office of these companies. In company with H. E. Sanderson, the Pacific Coast district manager, he will soon make his annual tour of the entire Coast.

A. B. Domonoske, instructor in mechanical engineering at the University of California, while making a recent bomb calorimeter test at the Potrero gas works of the Pacific Gas & Electric Company, underwent a severe accident from a premature explosion. He will be confined at the German Hospital for some days suffering severe burns in the hands and face.

J. W. White, chief engineer of the Vix Engineering Company, has returned to San Francisco, after spending about two months in investigating the subject of producer gas as applied to power and pumping, and visiting numerous plants in the East and Middle West. The operations of the Diesel-Willans and other gas engines, as well as the Humphrey gas pump, were investigated, with a view to ascertaining the most effective methods of utilizing California oil.

Chas. F. Uebelacher, vice-president and general manager of the Elmira (N. Y.) Water, Light & Railroad Company, **Chas. N. Black**, vice-president and general manager of the United Railroads of San Francisco, and **William von Phul**, vice-president of the American Cities Company at New Orleans, have been admitted to partnership in the firm of Ford, Bacon & Davis. Mr. Uebelacker is chief engineer for the firm. The principal branch offices of the firm at 921 Canal street, New Orleans, and 85 Second street, San Francisco, will each be in charge of a resident partner.

OBITUARY.

Richard T. Laffin, district manager of the Stone & Webster interests in the State of Washington, died June 26 at his home in Seattle, aged 49 years. He was born in Maine, and went from Boston to the Philippines to become manager of the Manila street railway system. He directed all the street railway, light, power and engineering operations of Stone & Webster on Puget Sound. Mr. Laffin was an efficient and capable public servant and his loss will be keenly felt.

ELECTRICAL CONTRACTORS' NOTES.

The Chamber of Commerce of Palo Atlo on learning that one of the contractors' sight-seeing excursions is to take in Palo Alto, have appointed a committee of seven to see that the contractors and their guests are well taken care of.

The St. James Hotel will be headquarters for the Electrical Contractors' Convention at San Jose. Reservations should be made as soon as possible.

The secretary's temporary office in the St. James Hotel will be open for the validation of railroad tickets from July 23d to July 28th. Tickets are good from July 14th to July 27th, going, and from July 24th to August 1st returning.

Newbury, Bendheim Electric Company have been awarded the electric work at the hospital at the Presidio for the sum of $9545 with an allowance of 12 cents per lb. for the old copper.

The Hicks Company have been awarded the general contract for the State Armory in San Francisco for $250,000. The General Electrical Contracting Company are the low bidders for the State's portion of the electric work and the Central Electric Company low bidders for the United States government part. The entire job amounts to about $1100.

McQUISTON ADDRESSES ADVERTISING MEN.

J. C. McQuiston, manager of publicity for Westinghouse interests, and also president of Pittsburg Publicity Association, addressed the San Francisco Advertisers' Association at its noon-day meeting Wednesday, June 26th. He dwelt upon the benefit to be derived from educational advertising on the part of large corporations. He stated that it was necessary not only to render public service, but to inform the public of the investment, risk and effort expended in rendering that service. He illustrated this point by referring to his trip across the continent, showing how a passenger could enjoy the conforts and picturesque scenery en route accepting all as a matter of course and losing sight of the tremendous sacrifice necessary to provide the roadway, the trains and equipment. When the passenger is made acquainted with figures as to the investment involved in bridging valleys, tunneling mountains and in providing luxurious trains, affording the comforts of a high class hotel, he will be less prone to criticise the corporation and more than likely wonder how it is possible to have such service rendered at such a reasonable cost.

The publishing of information calculated to educate the public as to the operations of the public service corporation is the solution of checking the antagonism on the part of the people.

Mr. McQuiston also referred to the advertising being done by large manufacturing corporations and the relation of such advertising to the local advertising of individuals and companies in cities and towns throughout the country.

He likened the advertising of the manufacturer, which is natural in scope, as being the high potential feeder and showed the advantages to be derived by distributers throughout the country, in so framing their advertising as to connect up their local effort with this national effort. He pointed out that in the broad and most comprehensive advertising, benefits must naturally accrue to the competitor, but that it was his belief that the chief aim should be to benefit the industry followed, having faith to believe that through salesmanship, that quota of return deserved and earned, would be realized. He stated that he believed that in the broadest and most beneficial advertising there was no room for petty selfishness and that we should not hesitate to carry out educational advertising campaigns, simply because in the building up of an industry, we helped competitors by the creation of a larger market. He illustrated this point in particular by referring to the advertising the Westinghouse companies are doing to encourage house wiring and to encourage the use of electrical devices in the home, and the application of electric motors to supplant antiquated methods.

He proceeded to explain the many methods being followed by the Westinghouse companies to help central station and electrical dealers to increase their business, referring specifically to the advertising helps, sent out gratuitously upon request, also Westinghouse street car cards, placards for windows, Westinghouse show window display, Westinghouse posters for bill boards and, most novel of all moving pictures embodying a great deal of human interest, showing the education of the housewife in the adaptation of electricity to the home.

These moving pictures were shown in Seattle before the employees of the electrical companies and in the month of July the same pictures wil be shown before the members of the advertising Association.

SAN FRANCISCO SECTION, A. I. E. E., MEETING.

A most interesting evening was enjoyed by the San Francisco Section of the A. I. E. E. on Friday, June 29. This, the annual meeting of year, was preceded by an informal dinner at Tait's Cafe. A letter from Ralph D. Mershon, president of the Institute, was read. Mr. Mershon requested western views of improving the Institute affairs. Recommendations were made for western membership on various committees, and it was also the sense of the meeting that one vice-president of the Institute be always chosen from western membership. A. H. Babcock, electrical engineer in charge of the Southern Pacific electrification in Alameda County, California, entertained the members with an instructive lantern slide lecture covering the essential points in his activities of suburban electrification.

TRADE NOTES.

The Great Western Power Company, San Francisco, Cal., has ordered from the General Electric Company three 750 k.v.a. 22,000/2400 volt transformers for a substation at Sacramento.

The Mount Whitney Power & Electric Company, Visalia, Cal., will install in its station a new 937 k.v.a. turbo generator, 25 kw. exciter set and switchboard, which were recently ordered from the General Electric Company.

The Yuba Construction Company, San Francisco, Cal., has recently ordered from the General Electric Company for installation on a big river dredge at Sumpter, Ore., one 200 hp. motor, six smaller induction motors ranging from 2 to 75 hp. and switchboard.

The employees of the Pacific Gas and Electric Company were entertained last Friday evening in the ballroom of the Hotel St. Francis, by the Westinghouse Electric and Manufacturing Company's stereopticon lecture, entitled "Mrs. Thrifty." The affair was well managed by the Westinghouse publicity department.

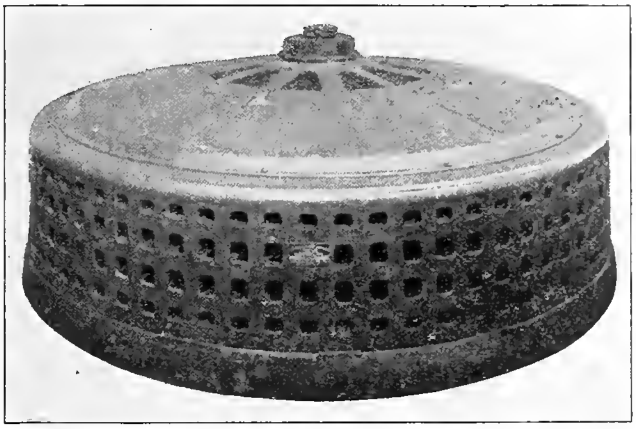
The Allis-Chalmers Company was recently awarded a contract to supply all of the transformers needed by the Coalinga Water & Electric Company for their coast extension. The transformers are to be of the outdoor type, similar to those furnished by the same company to the San Joaquin Electric Power Corporation.

McGlauflin Manufacturing Company, manufacturers of eucalyptus insulator pins at Sunnyvale, Cal., have recently shipped to the Northern Electric & Manufacturing Company at Vancouver, B. C., 3000 standard eucalyptus pins and are at present making 6000 large 12 in. pins and 1000 pole top brackets, oil treated, that go to Canadian Collieries (Dunsmuir), Union Bay, B. C.

INDUSTRIAL

MAMMOTH GENERATORS FOR GIGANTIC HYDROELECTRIC DEVELOPMENT AT KEOKUK.

In the largest power house in the world where will be wrested from the mighty Mississippi River, the "Father of Waters," the greatest single conservation of energy ever harnessed for the service of mankind, will be installed ultimately thirty immense vertical water wheel type alternating generators that rank as mammoths among machines for generating electric current. These generators will be placed in the hydroelectric power at Keokuk, Ia. When completed this building will measure 1750 ft. long by 123 ft. wide by 133 ft. high above the foundations and the plant will develop with the final entire installation over 300,000 horsepower.



One of the Mammoth Generators for the Keokuk Power House.

This gigantic concentration of energy is to reach out and wrestle with the machinery, lighting and traffic of towns and cities within a zone of 150 miles or more from Keokuk.

The great dam, the greatest power dam ever constructed, for impounding the billions of gallons of water to revolve the water wheels, or turbines, extends from Keokuk on the Iowa shore to Hamilton on the Illinois bank of the river, a distance of 4568 feet. It is surmounted by a viaduct carrying a 29 ft. roadway; rises 50 feet above the average river bed, and contains 119 spillways controlled by steel floodgates, each 30 ft. wide by 11 ft. high and operated by an electric hoist. This structure is being built in the turbulent stretch of the Mississippi River at the foot of the Des Moines Rapids, which are impassable most of the year. Constructed entirely of concrete, the dam will be the longest monolithic structure in the world, having a total overall length of 9096 ft.. In the works are also included a canal lock, 110 ft. wide by 400 ft. long with a lift of 40 ft. on the Iowa side of the river and a drydock alongside the lock.

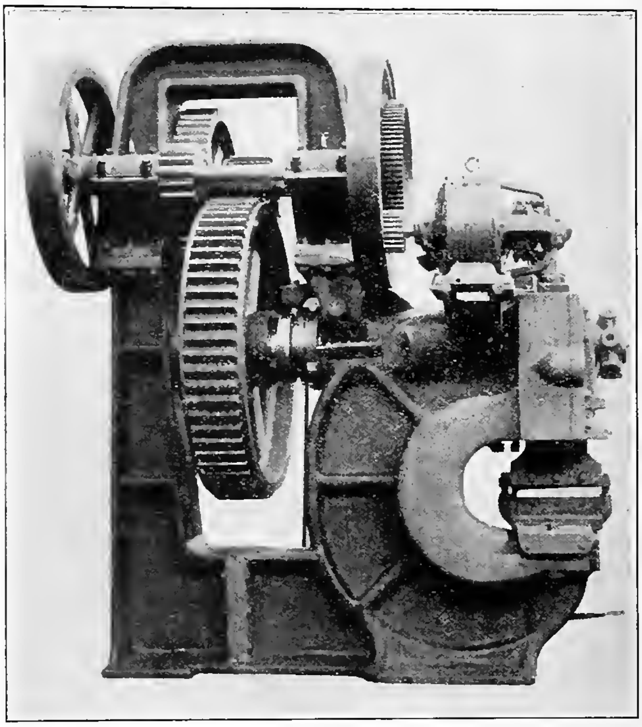
The initial installation of electric generating units will include fifteen alternators direct connected to the same number of vertical hydraulic reaction turbines of the single runner type, which will occupy the north half of the power station. Each turbine and generator will form an independent unit. Each wheel, mounted on a vertical shaft 25-in. in diameter, in a spiral chamber 21 ft. 3 in. in diameter and moulded in the concrete substructure, will operate at a constant speed of 57.7 revolutions per minute and will have a normal capacity of 10,000 horsepower.

The initial equipment will probably be in operation by the middle of 1913. St. Louis is 135 miles distant from Keokuk and is the first as well as the largest city to avail itself of the power to be transmitted over the high tension 110,000 volt lines. Street railway and electric light companies in that city have already contracted for 60,000 horsepower.

PUNCH AND SHEAR PRESS.

Economy of floor space, always an important item, is particularly so in a machine shop when it is desired to install any additional tools. The accompanying illustration will indicate how this may be effected in the case of motor-driven punch and shear press, made by the Cleveland Punch and Shear Works, Cleveland, Ohio. The arrangement of overhead gearing renders it possible to make a very compact machine and one that is economical of floor space.

The machine complete with its motor weighs approximately 50,000 pounds. It is designed for very heavy work, having sufficient capacity to shear twelve inches of 1½ in. flat bars, and to punch a five-inch hole in 1½ in.. plate. The



Punch and Shear Press.

various attachments such as those for angle shearing, bar shearing, and punching are interchangeable.

The motor is of 25 horsepower capacity at 230 volts,, and is of the well known direct current, commutating pole type, specially adapted for this kind of work by the Westinghouse Electric & Manufacturing Company.

NEW CATALOGUES.

A. L. Ide & Sons of Springfield, Ill., the well-known manufacturers of ideal engines, have just published Bulletin No. 20 on Ideal Corliss Valve Engines. The working of the Corliss valve is illustrated in detail and will prove of interest and profit to the engineer.

The Nelson Valve Company of Philadelphia has just issued Catalogue S showing their entire line of steel valves. The catalogue is unique in that it shows steel valves made of acid open hearth steel. The arrangement of the booklet is systematic and easily accessible to architect and engineer.

G. A. Wilbur, electrical manufacturers' agent of San Francisco, is distributing bulletins Nos. 6 and 7 of the Philadelphia Electrical & Manufacturing Company. The former bulletin deals in "Pemco" tungsten arc lamps while the latter describes incandescent street lighting fixtures of similar make.

NEWS NOTES

INCORPORATIONS.

SANTA CRUZ, CAL.—The Santa Cruz Electrical Supply Company; capital $6,000, subscribed in full, by C. H. Fredson $3000, C. E. Glaine $2000 and M. L. Fredson $1000.

LOS ANGELES, CAL.—La Grande Source Water Company; capital $75,000, par value of shares $75 each; incorporators, Peter Fedderson, Henry Lassalette, Robert C. Smith.

SAN BERNARDINO, CAL.—The Limited Mutual Water Company has filed articles of incorporation; capitalization, $20,000. Directors, W. G. Herwig, Earle Mills, Silas Wright. The company will develop water near Ontario.

ILLUMINATION.

GLENDALE, CAL.—The preliminary work has started on the $15,000 ornamental electric lighting system.

HARLEM, MONT.—The Harlem Electric Light Company is about ready to begin the installation of its new plant.

NEWPORT BEACH, CAL.—The city will soon issue bonds in the sum of $64,000 for the installation of electric light and power plant.

LOS ANGELES, CAL.—Representatives of the Coalinga Water & Light Company have asked for a franchise to cover Santa Maria, Santa Ynez, and Lompoc valleys. The franchise is advertised for sale July 22.

SEATTLE, WASH.—George A. Lee, chairman of the public service commission, anonunced that the commission had allowed the Puget Sound Traction, Light & Power Company to inaugurate, without the statutory thirty-day notice, a reduction in lighting rates and other service charges.

SPOKANE, WASH.—Bids on the revised plans of the Second avenue electrolier lighting system will be received up to July 16th. The estimated cost of the lighting system is $54,485.23, of which $9365.23 is for the lamp posts and $45,120 for the portion of the current to be paid for by the property owners.

VANCOUVER, WASH.—The local gas plant, the property of the Washington-Oregon Corporation, on July 1 passed into the hands of the Pacific Power & Light Company, of Portland, a subsidiary company of the Electric Bond & Share Company, which is closely identified with the Standard Oil interests.

COLFAX, CAL.—The lighting of all the ranches between this city and Clipper Gap and the residences in Colfax, Clipper Gap, Applegate and Walmar, the summer resorts and the Sanitarium here is the object of the movement started here for the formation of an Independent Power & Lighting Company. The plan is to construct an independent pole and wire system and to generate power for lighting purposes by the use of gasoline engines.

SEATTLE, WASH.—Bids for the construction of an electric lighting system and the erection of transmission lines at the four forts comprising the Puget Sound Artillery District, viz., Worden, Flagler, Casey and Ward, were opened and awarded by U. S. Construction Quartermaster G. M. Pourie to the following contractors: Fort Casey—Construction of system, estimated cost, $34,632; bidders, Evans, Dickson Company, Tacoma, $18,296; LePage-McKenney & Co., Seattle, $11,936; Chas. C. Moore & Co., San Francisco, $4,400. Fort Flagler—Transmission lines, estimated cost, $8759; distributed among three following: Meacham & Babcock, Seattle, $4900; Evans-Dickson, Tacoma, $1504; NePage-McKenney, Seattle, $2355. Fort Worden—Entire contract, Meacham & Babcock, Seattle, for transmisison lines, cost $7212. Fort Ward—Entire contract, electric station, NePage & McKenny, Seattle, $7603.

BOISE, IDAHO—Kissel, Kinnicutt & Co., the New York bankers, have in association with important New York banking interests and John D. Ryan, president of the Amalgamated Copper Company, just organized the Idaho Railway, Light & Power Company, a $30,000,000 Maine corporation, which has acquired all the properties of the Idaho-Oregon Light & Power Company, which operates light and power and interurbau lines between Caldwell and Boise City, a distance of 35 miles. The properties acquired by the new company include the following:

A hydro-electric power plant formerly owned by the Swan Falls Power Company at Swan Falls, on the Snake River, about 27 miles southwest of Boise. Present capacity 4,000 kw. This plant furnishes the Idaho-Oregon Light & Power Company with its power, and the latter company owns and operates transmission lines to Murphy, Dewey, Silver City, Nampa and Caldwell, Idaho.

The properties formerly of the Dewey Electric Light & Power Company, furnishing electric light to the city of Nampa.

The properties and franchises formerly of the Caldwell Power Company, furnishing electric light to the city of Caldwell.

An interurban trolley line (Boise & Interurban Railway), extending from Boise City to Caldwell, Idaho, about 35 miles.

An interurban trolley line extending from Boise City to Nampa, about 27 miles.

An interurban trolley line extending from Nampa to Caldwell, about eight miles.

A majority of both the $7,485,700 outstanding common stock and the $2,491,000 preferred stock of the Idaho-Oregon Light & Power Company; also about $1,443,000 of its "consolidated first and refunding mortgage" 6 per cent gold bonds, being all but about $170,000 of said issue now outstanding.

The holders of the common and preferred stocks of the Idaho-Oregon Light & Power Company have been given an opportunity to exchange their stock for the common stock and the 6 per cent preferred stock of the Idaho Railway, Light & Power Company, share for share, and the majority of this stock has already been exchanged on such basis. An opportunity is now being given to the minority holders of both classes of such stock to make a similar exchange if they so desire.

Albert H. Wiggin, president Chase National Bank, New York; Charles H. Sabin, vice-president Guaranty Trust Company, New York; John D. Ryan, president Amalgamated Copper Company, New York; Robert W. Watson, managing director Great Northern Power Company; Stacy C. Richmond, Winslow, Lanier & Co.; Samuel L. Fuller, Kissel, Kinnicutt & Co.; William Mainland, president Idaho Railway, Light & Power Company; Sinclair Mainland, director Idaho-Oregon Light & Power Company; A. E. Thompson, Oshkosh, Wis.; Grant Fitch, vice-president National Exchange Bank, Milwaukee, Wis.; R. M. Burtis, president Interstate Power Company, Oshkosh, Wis.

The banks interested are generally known as Morgan institutions.

TRANSMISSION.

LOS ANGELES, CAL.—Only twenty-two and a half miles of construction work remains to be completed on the great enterprise of 250 miles of mountains and desert bringing the Owens River through to the head of the San Fernando Valley.

LOS ANGELES, CAL.—A complete appraisal of the physical property of the Pacific Light & Power Company, one of the largest corporations in Southern California, has been begun by the valuation department of J. G. White & Company, Inc., of New York and San Francisco, and will keep a large staff of expert engineers and appraisers busy for four or five months.

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company has asked permission to run a transmission line from Bear Creek, in Placer County, to its north tower on the straits of Carquinez. It is intended as another trunk line feeder to its ramifying transmission system, and not to encroach upon local business en route. On that account the Commission will no doubt grant the request. Other companies are making no opposition for the same reason.

SAN BERNARDINO, CAL.—C. F. Potter, special counsel for the Southern Sierras Power Company, appeared before the Board of Public Service to urge that body to take immediate action in granting the desired rights of way across Los Angeles aqueduct lands for the transmission lines of this company. He urged that speedy action be taken as the company has had to lay off the steel structural crews and has high salaried men awaiting idle until it can proceed with the portion of construction that will have to be carried across the city's lands—a distance of about twenty-three miles.

RED BLUFF, CAL.—J. M. Eshleman and Alex Gordon, members of the State Board of Railroad Commissioners, listened here to the petition of the Northern California Power Company asking to be permitted to raise its rates outside the cities of Red Bluff, Redding, Kennett and Corning and in the towns of Cottonwood and Anderson. Up to January the company had a sharp competitor in the Sacramento Valley Power Company and the rates then prevailing were bargains for the consumers. The Northern bought the Sacramento Valley in January, and it now wants to restore rates to the non-competitive figure. The Railroad Commission, under the new law, stands in the way. The company officials claimed that the power system was worth $20,000,000, though their figures showed only $12,500,000. The big difference was explained to represent the value of water rights.

SAN FRANCISCO, CAL.—The Oro Electric Corporation, headed by J. W. Goodwin, which has plants in Butte and Plumas counties, has asked permission to extend its transmission line into Alameda County. This means it plans to compete in the sale of electric light and power in the San Francisco Bay Region. The Commission began taking testimony in the matter recently. Representatives of three other companies were there to oppose the application. H. H. Noble's Northern California Electric Company, does not want this new corporation in the section of the State where it is operating. The Pacific Gas & Electric and the Western States Gas & Electric companies are also in opposition. The former does not think this new corporation via Sacramento and Stockton into Alameda County and the bay region in general, is necessary for the public good. The Western States Gas & Electric, which is the property of a Chicago syndicate operating in and around Stockton and in Contra Costa County, wants the new company kept out of its territory.

TRANSPORTATION.

SAN DIEGO, CAL.—The street car line to Angelus Heights will soon be electricized.

KITSALANO, B. C.—The B. C. Electric Railway Company announces that new car barns and shops will be erected on the reserve here.

LOS ANGELES, CAL.—Within a short time work of installing a three-rail system on San Pedro street, in order to relieve congested traffic conditions, will be commenced by the Pacific Electric and the Los Angeles Railroad Company.

REDONDO, CAL.—Right of way has been secured and survey made by the Pacific Electric Company for a line from this city to Torrence.

VANCOUVER, WASH.—The extension of the electric line from Sifton to Hockinson, a distance of about six miles, will be made this summer.

HAMMOND, ORE.—A franchise to operate an electric railway in this city has been granted to Geo. A. Robinson, road to be completed inside of a year.

SANTA BARBARA, CAL.—Application has been made for a franchise for a street railway line in Santa Barbara. Sealed bids will be received up to July 18th.

WHEELER, ORE.—Articles of incorporation of the Nehalem Harbor Company were filed Tuesday, giving to the company authority to buy and sell real estate, build and operate water systems, build and operate electric light plants.

SEATTLE, WASH.—Ordinances introduced at the meeting of the City Council seeking to force the Puget Sound Traction, Light & Power Company to make "necessary and reasonable extensions of existing street railway lines," and to force an interchange of transfers between all street railway companies operating within the city, will be taken up for consideration next Friday morning by the franchise committee.

SACRAMENTO, CAL.—Two railroad franchises, one to the Oakland-Antioch line to operate cars on M street from the M street bridge to Third and on Third to I street and the second to the Central California Traction to extend its lines in Oak Park, on Sacramento avenue from Magnolia to Thirty-sixth and on Thirty-sixth to Park avenue were granted by a unanimous vote of the city trustees after the ordinances providing for these grants were made to conform as closely as possible with the provisions of the new city charter.

SAN FRANCISCO, CAL.—A compromise plan whereby the city will be able to operate the Geary street municipal railway upon the outer tracks in lower Market street to the ferry and the United Railroads to run Sutter street cars over the same route has been presented by Supervisor Vogelsang to other members of the public utilities committee and Mayor Rolph. Vogelsang's suggestion embraces, besides joint use of the lower Market street tracks by the Geary and Sutter street cars, a joint use of current, poles and wires in the disputed territory, the settlement of pending litigation and an exchange of transfers from the city's Geary street road to the Fillmore and Devisadero street lines of the United Railroads. It is provided that the action now pending in the United States Circuit Court be dismissed and that the city be given the right to operate in Point Lobos avenue upon the payment of the proportionate cost of construction and maintenance.

PORTLAND, ORE.—A modern electric railway terminal embracing a modern office building covering a full city block in the business district, a steel bridge across the Willamette River, a four-track system between Oswego and Aurora, electrification of 340 miles of railroad, erection of car shops, improved and rapid service between Portland and scores of communities in Western Oregon all entailing an outlay of between $18,000,000 and $28,000,000, in the next two years, are features of one of the greatest railroad development projects ever undertaken in the Pacific northwest. They are all embraced in the plans of the Southern Pacific for the territory immediately tributary to Portland. The outline of the terminal plans followed the official statement by Vice-President and General Manager E. E. Calvin that the Southern Pacific had secured the Portland, Eugene and Eastern and other Welch properties; the Salem, Falls City and Western, known as the Gerlinger road, and the Canby-Molalla road. These purchases together with the changing of the motive power of the Fourth street line and other lines radiating out of Portland, Salem, Eugene, Albany, Corvallis and McMinnville represent a cost of close to $10,000,000.

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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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VOLUME XXIX SAN FRANCISCO, JULY 13, 1912 NUMBER 2

THE SAN FRANCISCO HOSPITAL POWER PLANT

BY ALFRED H. POTBURY.

The San Francisco Hospital will ultimately represent an expenditure of about two million dollars. The site of this institution, at Twenty-second and Potrero avenue, is 866 feet by 760 feet with plans for three general groups of buildings, one general hospital group, one infectious group and one tubercular group.

The general hospital group now nearing completion includes administration, service and receiving building, four ward buildings, a nurses' home, a laundry and power plant building. Interconnecting all these buildings is a wide enclosed passageway beneath which in the basement is a similar passage or tunnel about 10 ft. square. The basement passage serves a dual purpose, that of a transportation way for supplies to and from the various electric elevators in each building and also as a conduit for the installation of various pipe lines and electric services distributed from the central power plant.

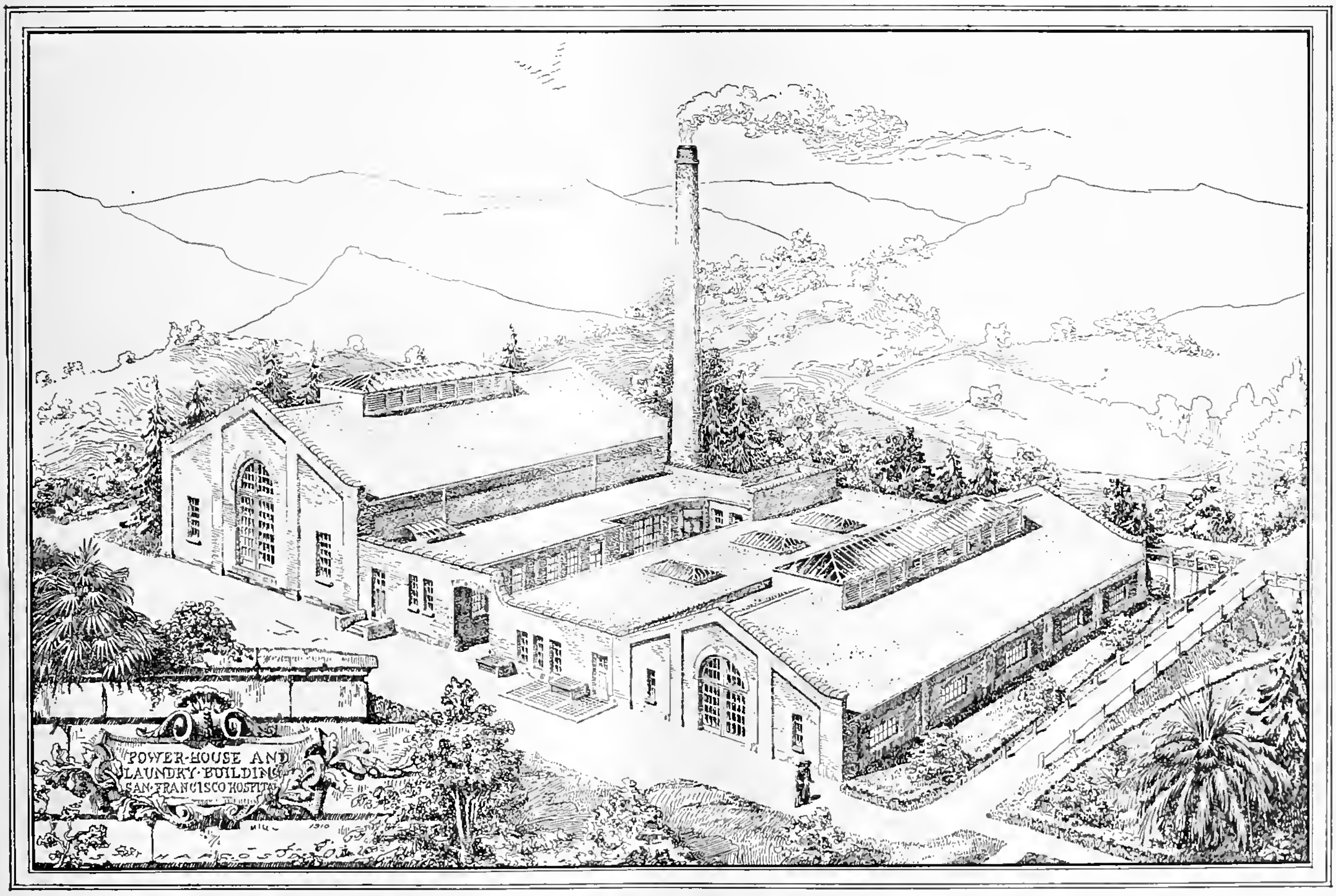


Fig. 1. Power House and Adjacent Buildings, San Francisco Hospital.

The size of these buildings, their unity of purpose, and the demands made by their equipment leads naturally to a power plant. Light, power, heat, steam and water must be ready as required.

The power plant building, shown in Fig. 1, is centrally located in the final completed plan which includes all three hospital groups, so that the matter of distribution will always be an economical one. The

power plant building includes also under the same roof, the laundry plant, the disinfector, the incinerator and refrigerating plant, but the power plant proper is separated from these other departments by partition walls

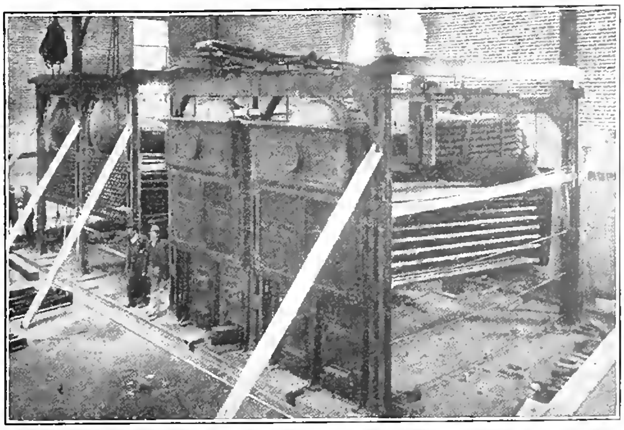


Fig. 2. Boilers and Settings During Construction.

which enclose a space approximately 70x75 ft. in size. The larger part of this space, forming the boiler room, is one story with the floor about 10 ft. below grade and the lowest point of the gable roof about 19 ft. above grade. This boiler-room space is on the eastern side of the building with the reinforced concrete chimney just outside of the east wall. The western side of the power plant room is divided into two stories. There is a mezzanine floor approximately 25x70 ft. which provides excellently for a turbine and generator room, while the space beneath this mezzanine floor serves for location of all auxiliary apparatus.

There are four 250 h.p. Risdon water tube boilers built for 175 lb. working pressure set in two battery settings. These boilers are of the suspended type with structural steel frames. Each boiler is equipped with a Foster superheater for 100 deg. superheat. Fig. 2

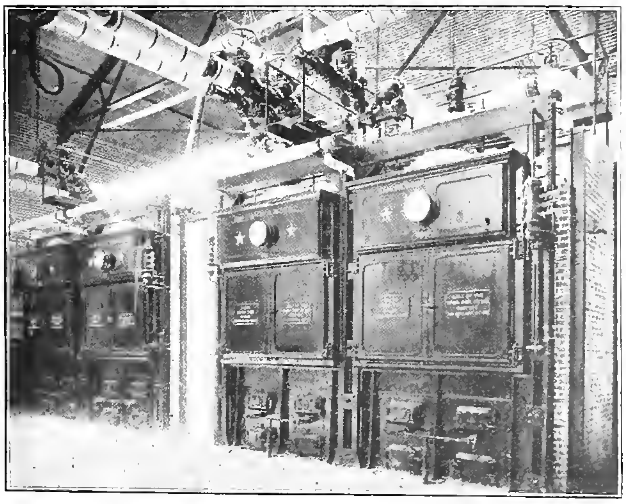


Fig. 3. Finished Boilers and Pipe Connections.

gives a general view of boilers and superheaters as they appeared during construction, with one battery about ready for the brick work. Fig. 3 shows boilers after completion of the plant and gives an idea of various pipe connections, main header, auxiliary header, runway for access to the various valves and the distributing lines leaving the boilers.

To the right of the boilers on the north side of the boiler room is the oil apparatus, which is the Dahl Mechanical Atomizing System made by the Union Iron Works. This system consists of a double set of 4½x2¾x4 duplex pumps, two No. 4 oil heaters, duplex

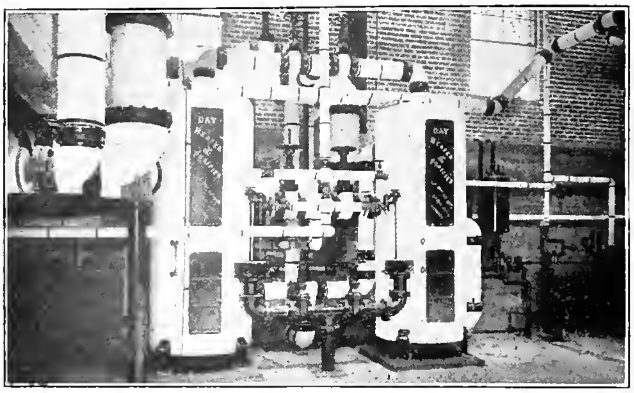


Fig. 4. Heaters and Purifiers With Auxiliarry Apparatus.

strainers, governor, thermometers, etc., as required to supply the eight burners. On the right side of Fig. 4 the oil apparatus is shown.

Fig. 4 also shows the two Day feed water heaters, each having capacity to heat 52,500 lb. of water per hour from 60 deg. to 204 deg. These heaters are of the open type, operating on exhaust steam from the turbines at about 3 lb. back pressure and equipped with a special system of heating trays in the upper part and with a filtering chamber in the lower part. The discharge from the Deane simplex vacuum pumps, operating on the heating system, is returned directly to these feed water heaters through a special arrangement for air vent and water seal at the rear of the heaters.

The 10x7x10 duplex Worthington feed pumps, shown in Fig. 5, are controlled in steam supply automatically by the control valves at the feed water heaters. The suction of these pumps is connected to the

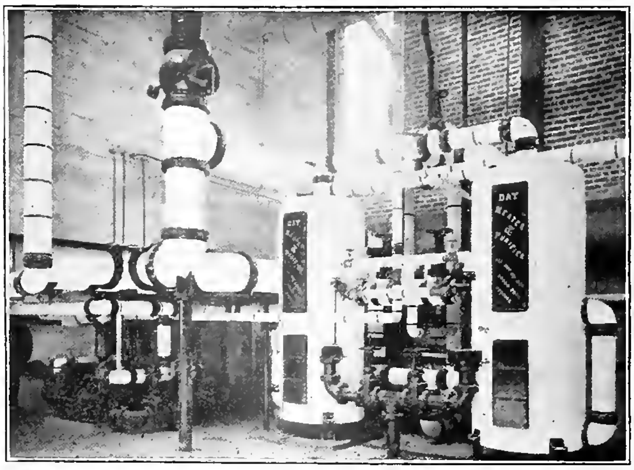


Fig. 5. Feed Pumps and Hot Water Heaters.

feed water heaters in which a constant level at filtering or suction chamber is maintained by the automatic steam supply valves to feed pumps. Any make up water necessary is hand controlled and is supplied through the top of the heaters.

To the left and at the rear of the feed pumps in Fig. 5 can be seen one of the two condenser type of domestic hot water heaters of the Blake Manufacturing

Company's make. These have a guaranteed capacity of 3000 gal. per hour from 50 deg. to 180 deg. The temperature is automatically controlled. These heaters operate on 3 lb. exhaust steam pressure with Dunham vacuum traps on the return to allow condensation to pass directly to suction of vacuum pumps.

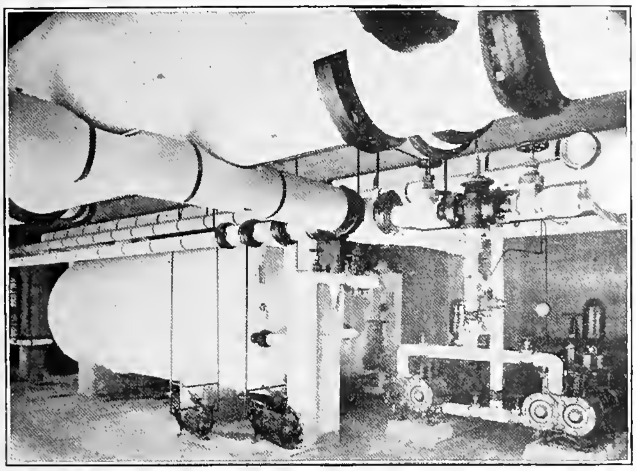


Fig. 6. Hot Water Pumps and the Emergency Hot Water Heater.

To the left of these domestic hot water heaters in the auxiliary apparatus space are the 10x7x10 Worthington domestic hot water pumps as shown in Fig. 6. These are for circulating hot water throughout the entire hospital and are automatically controlled by a Mason regulator to maintain a constant pressure in the hot water system.

Fig. 6 also shows the domestic hot water storage tank having a capacity of 3200 gal. This tank is equipped with a double brass pipe coil which is supplied with reduced pressure steam at about 40 lb. and which gives a secondary method of heating water used chiefly as emergency method in conjunction with the Blake heaters already mentioned. At the rear of the hot water storage tank is a returned tank for water storage having a capacity of 2500 gal. At the left of the hot water storage tank in Fig. 6 the steam ends of the 10 x 14 x 18 Dean vacuum pumps can be seen. These are controlled by a Mason vacuum governor to maintain a constant vacuum on the heating system return from the buildings.

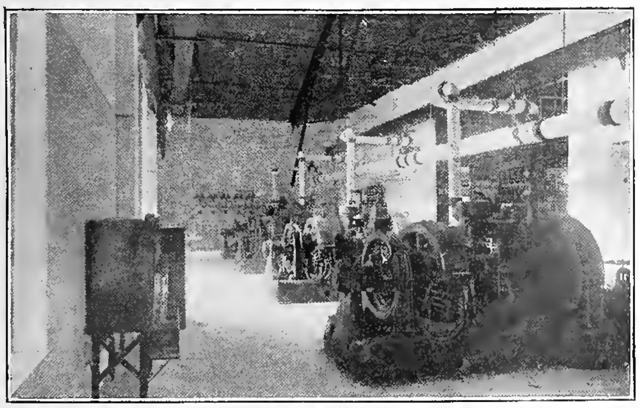


Fig. 7. Turbo-Generator Room, San Francisco Hospital.

Over the auxiliary apparatus room on the mezzanine floor is the turbine room, a general view of which is shown in Fig. 7. There are four 125 kw. General Electric Company turbo-generators arranged for three-wire distribution for 125-250 volts. The turbines are supplied with steam at 175 lb. pressure and 100 deg. superheat. The exhaust against 3 to 5 lbs. back pressure into the 16-inch main exhaust line to the heating system. The switchboard at the far end of the room is of General Electric Company's manufacture and is especially designed to meet the requirements of about twenty feeder circuits which pass out through the service building and thence to the main tunnel.

This entire installation was designed and supervised by the Mechanical Department of the Bureau of Architecture of the City of San Francisco. The power plant contract was executed by Robert Dalziel Jr. and the electrical installation by the Central California Construction Company.

POTENTIAL WATER POWER OF THE UNITED STATES.

The possible development of western water power is amazing. A resume of data collected by the Commissioner of Corporations at Washington in regard to this feature of undeveloped natural resources is herewith appended:

The statistics for undeveloped power are far from satisfactory. In the first place, many of the undeveloped power sites in the United States have never been surveyed or even examined, and in the second place, even where examinations and surveys have been made, the estimates of power are necessarily based upon certain engineering theories that are liable to error. In the investigation conducted in the field by this Bureau no effort was made to secure estimates for undeveloped power, except for those concerns that reported some undeveloped power. Estimates of the undeveloped water power in the United States were prepared (1908) by the United States Geological Survey for the National Conservation Commission. The difficulty of arriving at an accurate estimate was frankly admitted by the Survey.

From the data furnished by the Geological Survey there has been prepared in this Bureau a table of this power by states. It should be emphasized that this rearrangement is more or less arbitrary. For example, in many cases the drainage basin of a river extends over several states and it is difficult to allot the power possibilities of such a basin among the states involved. It is believed, however, that the distribution made is reasonably accurate. The table shows the power as computed by the Geological Survey on a basis of 90 per cent efficiency, and also on the basis of 75 per cent efficiency, adopted by this Bureau. It should be noted that the total figures given in this table on the basis of 90 per cent are not identical with those originally prepared by the Survey. The estimates of the Survey include nothing for the State of Pennsylvania, whereas they include the entire power of the Niagara River. These figures have been readjusted and minor readjustments have been made in other instances.

Table 6—Potential water power in the United States, by States, as computed by the United States Geological Survey and as revised by the Bureau of Corporations.

	Potential horsepower on basis of 90 per cent efficiency.		Potential horsepower on basis of 75 per cent efficiency.	
	Minimum	Assumed Maximum	Minimum	Assumed Maximum
United States	32,083,000	61,678,000	[1]26,736,000	[1]51,398,000
Western States:				
Montana	3,299,000	5,197,000	2,749,000	4,331,000
Idaho	1,394,000	3,080,000	1,162,000	2,567,000
Wyoming	927,000	1,566,000	773,000	1,305,000
Colorado	1,010,000	2,036,000	842,000	1,697,000
New Mexico	192,000	527,000	160,000	439,000
Arizona	1,071,000	2,038,000	893,000	1,698,000
Utah	892,000	1,581,000	743,000	1,318,000
Nevada	206,000	331,000	172,000	276,000
Washington	5,918,000	10,376,000	4,932,000	8,647,000
Oregon	3,777,000	7,935,000	3,148,000	6,613,000
California	4,109,000	9,382,000	3,424,000	7,818,000
Summary:				
North Atlantic States	2,670,000	4,910,000	[1]2,225,000	[1]4,092,000
South Atlantic States	2,813,000	5,107,000	[1]2,344,000	[1]4,256,000
North Central States	2,079,000	4,270,000	[1]1,733,000	[1]3,558,000
South Central States	1,726,000	3,342,000	[1]1,438,000	[1]2,785,000
West'n States	22,795,000	44,049,000	[1]18,996,000	[1]36,707,000

[1]Computed by deducting one-sixth from the figures showing potential horsepower on the basis of 90 per cent efficiency.

The developed water power in these states, including only developments of 1000 h.p. and over are shown in the following table:

Table 7—Developed water power in the United States of concerns having 1000 h.p. or over (including undeveloped power), by states:

	Developed and under construction. Commercial.	Manufacturing.	Owned by Commercial Companies but Undeveloped.
Western States:			
Montana	139,260	....	105,700
Idaho	52,100	....	42,300
Colorado	69,690	....	59,000
Arizona	16,200	....	......
Utah	52,700	....	2,600
Nevada	14,200	....	24,000
Washington	300,510	....	115,700
Oregon	95,777	....	143,600
California	429,467	6,000	732,749
Other States, not enumerated[1]	4,317	7,780	2,000
Summary:			
North Atlantic States	819,045	696,947	382,815
South Atlantic States	388,877	107,627	489,410
North Central States	511,406	225,774	534,792
South Central States	68,000	10,450	3,862
Western States	1,169,904	6,000	1,225,649
Other States, not enumerated[1]	4,317	7,780	2,000

NOTES FROM THE A. I. E. E. INCLUDING RESOLUTION ON SAN FRANCISCO, 1915.

The directors of the American Institute of Electrical Engineers held a meeting on June 27, 1912, at Hotel Somerset in Boston, where important matters of the Institute were brought up for action.

Upon recommendation of the Law Committee, the by-laws relating to the transfer of present associates and members under the special section of the constitution as adopted on May 21, 1912, were modified to eliminate the requirement that the names of applicants and their certifiers be published prior to their transfer; the provision of publication, however, after transfer, being retained.

Whereas, The Memorial of the Conferees on a General Engineering Congress prepared at the conference in San Francisco on January 15, 1912, has been before the Board of Directors of the American Institute of Electrical Engineers, together with the report of Mr. Calvert Townley, dated June 10, communicating the result of an informal conference on the same subject between representatives of the national engineering societies in New York, it was

Resolved, On recommendation of the Committee on Organization of the International Electrical Congress, San Francisco, 1915, that the following resolutions be adopted and transmitted to Professor W. F. Durand, president, and Mr. Otto Von Geldern, secretary, of the San Francisco Conference of January 15 on the General Engineering Conference.

Whereas, The next International Electrical Congress having been awarded in September, 1911, to the United States by the International Electro-technical Commission and by the International Electrical Congress of Turin upon the request of the American Institute of Electrical Engineers with the understanding that it should be held in San Francisco in September, 1915, the American Institute of Electrical Engineers is under obligations to carry out the plans for holding such a congress along the lines originally laid down by the commission, and is therefore unable to merge this congress with the General Engineering Congress proposed later in the year by representatives of various national engineering societies in San Francisco. The American Institute of Electrical Engineers reiterates the position taken by its board of directors on January 12, 1912, at which time it appointed delegates to the General Engineering Congress Conference, Messrs. H. A. Lardner, George R. Murphy, and S. J. Lisberger, and instructed them to inform the Conference that while being unable to merge the electrical with the general congress, it would be glad, so far as might be compatible with its obligations to the electrical congress, cordially to co-operate in the organization and conduct of the General Engineering Congress and to participate in its program. It was therefore

Resolved, That in response to the Memorial of the Conference on the General Engineering Congress, the American Institute of Electrical Engineers stands ready to concur in and to co-operate with whatever form the movement of the other societies may take, insofar as this co-operation is possible and consistent with its obligations already referred to in connection with the International Electrical Congress of San Francisco, 1915. To this end, although it is not feasible in view of the large financial and other responsibilities undertaken by the American Institute of Electrical Engineers in connection with the Electrical Congress and the accompanying meeting of the International Electro-technical Commission to participate to the extent suggested by the conference of June 10 of representatives of the national engineering societies in New York, which assigned to the American Institute of Electrical Engineers a participation equal to that of the American Society of Civil Engineers and amounting to a guarantee of $9000, with the privilege of having six representatives on the Joint Board of Control of the Congress, the American Institute of Electrical Engineers, nevertheless, hereby is glad to undertake, upon notification of the co-operation of the other societies in question, to guarantee an amount up to $3500, of the deficit or expense that the General Engineering Congress may incur, and to ask in view of this reduced participation the privilege of having but two instead of six representatives upon the governing board of the General Engineering Congress.

The twenty-ninth annual convention of the A. I. E. E. in Boston having been unusually successful, its program containing sixty papers, with particularly liberal entertainment features for members and ladies, and attracting a registration of 936, the board of directors passed most cordial and appreciative resolutions of thanks to Mr. Charles L. Edgar, convention chairman, and Messrs. Charles H. Davis, Louis D. Gibbs, W. H. Blood, and Frederick P. Valentine, chairman of sub-committees, and to the various institutions and corporations who had extended hospitalities to members during their visit. These resolutions were ratified by acclaim at the annual banquet and at the meetings of the various sessions of the convention on the following day.

A MODEL RELIEF ASSOCIATION.

A kindly and parental guidance over its employees by the executives of the modern public utility corporation has done much to heighten efficiency and loyalty among the rank and file. The executives of the Western States Gas & Electric Company, a Byllesby subsidiary having its main office in Stockton, have recently devised a relief association for the employees of their company. This plan, which has already been put into operation, seems to have so many good points in its favor, we publish the Constitution and By-Laws in full in order that other companies may have a model from which to build similar institutions:

CONSTITUTION.

ARTICLE I.

This Association shall be known as the Byllesby Relief Association.

ARTICLE II.

This Association shall be composed exclusively of such of the officers and employes of the Western States Gas and Electric Co., its allied and subsidiary companies, as may unite with it; and the membership of each herein shall cease with the date at which the connection of such member of the Association with said company, or companies terminates.

ARTICLE III.

Its objects shall be to provide for its members while they are disabled by reason of sickness or of injuries received since said member became a member of this Association, and at their death for their families; Provided, That said sickness or death was not caused by intemperance, suicide or immoral or disorderly conduct.

ARTICLE IV.

Such provisions shall include: (1) Payment to each contributor the sum of $7.00 per week while totally unable to labor, and $1.00 per day thereafter; but after six months' disability this payment shall be reduced one half, and after one year shall cease; Provided, That no member shall draw more than $200.00 in one year on account of sickness or disability. (2) In the event of the death of a member there shall be paid to the person designated by him in the application for membership to receive the same, or if there be no such person, then to his legal representatives the sum of $100.00. (3) In the event of the death of the wife of the member there shall be paid to said member the sum of $50.00. In the event of the death of the mother of a single man, there shall be paid to said member the sum of $50.00; Provided, That on account of the death of a mother but $50.00 be paid in one family, and Provided further, That in no event shall more than one benefit be paid to one family for the death of a wife or mother within a period of two years. A member may, however, waive one of said benefits in favor of the other. Provided further, That upon the certificate of the Medical Examiner, made at time of application for membership by employe, to the effect that the wife or mother is not in satisfactory physical condition the Association shall be exempt from payment of any death benefits on account of either to such husband or son.

ARTICLE V.

Members leaving the service of the company or who shall withdraw from the Association shall be entitled to receive from the Treasurer thereof the full amount of the contributions paid by them, less their pro rata share of the disbursements made in accordance with the provisions of the Constitution, during their term of membership.

ARTICLE VI.

The affairs of the Association shall be managed by a Board consisting of eight employes of said company or its subsidiary or allied companies; and such Board of Managers of eight members shall hold office for one year and until others are duly elected and qualified to take their place as managers.

ARTICLE VII.

Election for Managers shall take place the last Friday in September of every year. At these elections for Managers each member shall be entitled to vote, in person or by proxy.

ARTICLE VIII.

No persons shall be entitled to receive any compensation or salary by reason of his service upon the Board of Managers; but each Manager shall be paid for any trips or time he may lose by his attendance at these meetings by the Association.

ARTICLE IX.

The Board of Managers shall make a semi-annual report in writing of its doings to the Association at its regular meeting in September and March.

ARTICLE X.

The moneys and securities belonging to this Association shall be intrusted to the official custody of the Auditor of the several companies whose employes comprise this Association, to be held subject to the requisition of the Board of Managers. Moneys not needed for the current expenses of the Association may be invested by the Board of Managers in United States bonds or other first-class securities.

ARTICLE XI.

The Managers will elect a Secretary from the members, who will perform the usual duties or as may be assigned by the Board of Managers, and who will act as Librarian of all books that may come into possession of the Association and shall receive as compensation for such services an amount which shall in no case exceed the regular monthly dues.

ARTICLE XII.

In settling accounts with members who shall withdraw from or cease to belong to the Association computation shall be made with reference to the first day of the month in which settlement takes place and shall not include fractional parts of the month.

ARTICLE XIII.

Should any difference arise between claimants for benefits herein set forth and the Board of Managers the difference shall be submitted to three arbitrators who are members of the Association, one to be chosen by each party and the third by the two others. The decision of the arbitrators shall be final.

ARTICLE XIV.

All contributions due by members of this Association shall be paid in advance by being deducted from the wages, or salaries, due to them by the Company; and any person who becomes a member of the Association hereby assents to such deduction, and the Treasurer of this Association is authorized to receive the same.

ARTICLE XV.

Payment shall not be made in cases of disability of less than seven days' durations, and then only when evidence satisfactory to the Board of Managers has been received that sickness or injury has caused total disability for labor for the time specified in the claimant's application. A certificate of a physician of the Association shall in all cases be furnished, unless the majority of the Board of Managers shall be satisfied by other evidence of the justice of the claim.

ARTICLE XVI.

The Manager shall from time to time provide for the visitation of the members on the allowance list, and no member refusing to submit to an examination by such visitor shall be entitled to receive any benefit from the fund during the continuance of such refusal.

ARTICLE XVII.

All liabilities on account of death shall be payable within thirty days after receipt of notice of death.

ARTICLE XVIII.

For the several benefits herein set forth each member shall pay $1.00 for entrance and $1.00 as dues per month thereafter; Provided, That when the total amount of active funds to the credit of the Association shall be less than is actually needed, the Board of Managers are authorized to levy and collect, in the same manner as other dues, such a pro rata assessment as the Board of Managers may deem necessary; Provided further, That such assessment shall not exceed fifty cents per month from each member.

Any person eligible to membership in the Association who does not become a member within six months from date of eligibility shall pay an initiation fee of $3.00.

ARTICLE XIX.

All moneys received by the Association other than the contribution of the members, or moneys made by entertainments, shall be kept in reserve (unless needed to pay benefits provided for herein) as a surplus fund, and the interest derived therefrom shall be credited to each individual account on the 1st days of September and March in each year; Provided, That NO account of less than three months' standing shall receive any interest therefrom.

ARTICLE XX.

No employe not in good physicial health or under 18 years or over 60 years of age shall be eligible for membership in this Association; when any member shall reach the age of 60 years dues and sick benefits shall cease, but death benefits will be paid to his legal representative, provided such member is still an employe.

ARTICLE XXI.

Any person who is now or may hereafter be employed by this company or its constituent companies noted above who may have an injury to body or limb may become a member of this Association and shall be entitled to all benefits through sickness or death; Provided, such sickness or death was not caused by said previous injury.

ARTICLE XXII.

Any member who may become injured in any way while at work for the company and who is drawing his regular wages from the said company shall not be entitled to any benefits from the Association while drawing such regular wages.

ARTICLE XXIII.

This Association may be dissolved at any time by a vote of three-fourths of all the members and in the event of such dissolution, all surplus funds on hand belonging to the Association shall be distributed pro rata according to the length of time a member has belonged.

The company guarantees the safe custody and proper disposition of all moneys or securities belonging to the Association entrusted to the care of its Auditor as provided in the Constitution, Article 10.

ARTICLE XXIV.

None of the provisions of this Constitution shall be altered, modified or repealed, nor shall any new rule be made, except at a general meeting of the Board of Managers. Thirty days' notice must be given in writing of any proposed change or modification.

BY-LAWS.

1. The annual election of the Board of Managers shall be held each year at the place and during the hours fixed by the Board of Managers; and the members of the Association shall be notified of such election by the Secretary's posting seven days previous notice thereof. The election shall be by ballot, and the Board of Managers shall appoint necessary inspectors, not members of the Board, to conduct the same and certify the result thereof.

2. The members shall organize at the next regular meeting day after their election, by electing a President and Vice President by ballot ;and in like manner shall also elect a Secretary, who shall be a member of the Association but who need not be one of the Managers. The Board shall engage a physician, or physicians, whose charges for medical and surgical services shall be paid by the Association.

3. The President shall appoint a Finance Committee, consisting of three members of the Board of Managers; and also a relief committee, consisting of not less than three nor more than five members of the Association.

4. The President shall also appoint a Committee on Membership, to consist of three members, whose duty shall be to pass upon all applications for membership, its recommendations to be made to the Board of Managers for action at every monthly meeting.

5. All officers, except the Treasurer and Managers, may be removed at any time by a vote of a majority of the Managers; otherwise they hold their respective offices for one year and until their successors are elected and qualified.

Any manager may be removed at any time by a vote of two-thirds of the members of the Association. Two weeks' notice of such proposed action shall be given and ballots cast in like manner as provided for election of Managers in Section 1 of the By-Laws.

6. Stated meeetings of the Board of Managers will be held on the third Friday of each month and special meetings may be called at any time by the President, and he shall call such meetings whenever requested to do so in writing, by any five members of the Board of Managers. Whenever the day for any meeting falls on a public holiday said meeting shall be held on the following Monday.

DUTIES OF OFFICERS.

7. Subject to the Constitution and By-Laws, and such orders as the Board of Managers may from time to time make, the President shall have the chief management and direction of the affairs of the Association and shall sign checks on the Treasurer therefor.

8. The Vice-President shall be vested with all of the powers, and required to perform all of the duties of the President, during the latter's absence.

9. The Secretary shall keep the books and minutes of the Association.

10. The Treasurer shall draw checks for payments of all bills and expenditures.

11. The Finance Committee shall audit all accounts annually, and shall certify the same to the Board of Managers.

12. No member of the Association shall, without the assent of the Board of Managers, assign or transfer to any person other than that named in his application, any benefits due or to become due to him by the Association; and by any such attempted assign, without such consent, shall be a forfeiture of all claims of the beneficiary to such benefit, unless the Board of Managers shall otherwise determine.

13. Each and every vacancy occurring in the Board of Managers shall be filled by the remaining Managers and the person selected to fill such vacancy shall serve for the unexpired term of the Manager whom he succeeded.

14. Members will not be entitled to the sick or death benefit until they have been members and paid dues for four months. All members will, however, be entitled to medical attention from the date of acceptance of their application.

15. It shall be the duty of every member detained from work on account of disability to immediately inform the Secretary of the Association.

16. The Association is bound to the payment of allowances only when the disability is thus reported, and no claim that has not been so reported will be considered.

17. Any member of the Association who is sick and wishes to leave the city must first obtain the consent of the Association's physician, otherwise he will not be entitled to benefits.

18. Every member leaving the service of the company must

surrender his certificate of membership (which will be his last month's card, and also his copy of the Constitution, or twenty-five cents will be deducted therefor) to the Treasurer of the Association before any settlement of his account will be made.

19. The Treasurer will take a receipt from any member leaving the Association showing that said member has received the return of all contributions less his pro rata share of disbursements.

20. The Board of Managers reserves to itself the power of approving or declining any application for membership.

21. All applications for membership shall be in the hands of the Membership Committee three days before the regular monthly meetings of the Board of Managers.

22. Five member of the Board of Managers shall constitute a quorum for the transaction of all business not otherwise specified.

23. The order of business shall be as follows:

1. Calling of roll.
2. The reading of the minutes of preceding meeting.
3. Communication and reports from the President.
4. Reports of other officers.
5. Reports of standing committees.
6. Miscellaneous business.

But at special meetings the business for which the meetings was called shall have preference immediately after the reading of the minutes.

24. Any one or more of these By-Laws may be altered, amended, added to or repealed by a majority of the Board of Managers after thirty' days notice in writing.

INTERNATIONAL ELECTRICAL CONGRESS.

At a meeting held in Boston on June 25 of the society representative members and of the committee on organization of the 1915 International Electrical Congress of San Francisco arrangements were completed for organizing the congress so as to assist and not conflict with the National General Engineering Congress that will be held in San Francisco in 1915. The International Electrical Congress has already been authorized by the International Electrotechnical Commission, which has recognized jurisdiction in such matters. It will be attended by representatives from electrical engineering societies and the governments of countries throughout the whole world. The committees thus far appointed have been selected by the American Institute of Electrical Engineers to obtain the proper co-operation with the American societies to insure the success of the congress. Both American and foreign societies will soon be requested to appoint delegates of their own selection to represent them in the congress itself. The preliminary details are being arranged by the executive committee, consisting of Dr. C. P. Steinmetz, president; Dr. A. E. Kennelly, C. O. Mailloux, W. D. Weaver and H. A. Lardner, vice-presidents; Dr. E. B. Rosa, secretary; P. S. Millar, treasurer and business manager.

NEW FOREST READJUSTMENTS.

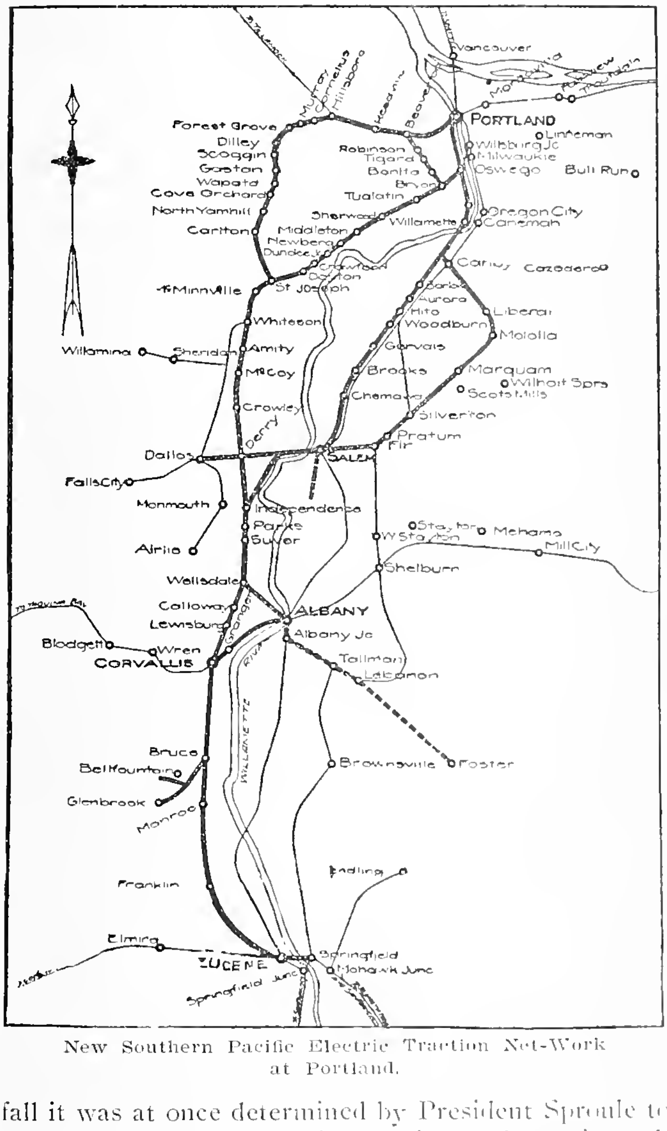
President Taft has just made considerable changes in national forests in Montana, Arizona, Nevada, Utah, and California through presidential proclamations modifying the boundary lines. By these changes nearly 275,000 acres of land are eliminated from the forests, about 65,000 acres are added, and about 55,000 acres are transferred between two forests, while a new forest is created by the division of an old unit into two.

GIGANTIC ELECTRIFICATION OUT OF PORTLAND.

In the illustration shown herewith the heavy lines are electric roads authorized for immediate construction, light lines are existing Southern Pacific steam roads and the dotted lines are projected electric roads. Such is the gigantic network of electrification now under way by the Harriman lines in and about Portland, Ore.

Mr. Calvin of the Southern Pacific Company is quoted recently as saying:

"The O.-W. R. & N. Co. already had made a start upon electrical development in the Willamette Valley by arranging to change the West Side lines to McMinnville and when we took over the property last



New Southern Pacific Electric Traction Net-Work at Portland.

fall it was at once determined by President Sproule to enlarge the plan to take in practically the entire valley. We, therefore, had our agents acquire for the Southern Pacific Company the Portland, Eugene & Eastern Railway and, through it, the Corvallis and Alsea Railroad, which is under construction south to Eugene, and the street car system in Salem formerly owned by the Portland Railway, Light & Power Company.

Material on Ground.

"The work of converting lines between Portland and McMinnville to electric operation is well along

and all of the material needed is upon the ground. We will proceed at once with the electrification of the West Side line from McMinnville to Corvallis and of the Corvallis & Alsea from Corvallis to Eugene, with a short-line cutoff between Wellsdale and Albany; will electrify the Salem, Falls City & Western, which we own, from Dallas to Salem, crossing the Willamette River upon the new Salem, Falls City & Western bridge, which is now under construction. There will be a cutoff in this line from a point about half way between Salem and Derry to Independence.

"We are now acquiring right of way for a double-track line, with room for four tracks eventually, between Oswego and Aurora, from which latter point an electric line will be built parallel to our present steam line to Salem. We also have under construction a line from Canby to Mollala and from Salem to Fir, and will build a connection between Mollala and Silverton, providing a through line from Canby via Silverton to Salem.

Salem Branch Contemplated.

"This development, which has been authorized, will give us an interurban electrical system of 340 miles, with an additional 35 miles of city lines in Salem, Albany, Eugene and Corvallis. We have under contemplation as well a branch line southerly from Salem to serve a rapidly-developing territory, and a branch line southeasterly from Lebanon.

"It is apparent that this development of electric interurban lines and additions to city electric systems as well as double-tracking and otherwise improving existing city lines will greatly benefit such Willamette Valley cities as Salem, Albany, Corvallis and Eugene. Take Salem, for example: It will be the center of new lines radiating in four or five directions and its electric street railway facilities will be vastly enlarged and improved as quickly as the necessary rights are obtained. Besides being on the new north-and south electric trunk line, it will be connected in the best possible manner with all the existing steam line mileage on both sides of the valley."

Mr. Strahorn is directing the affairs of the Portland, Eugene & Eastern and affliated properties and will have charge of construction of the electric lines with R. T. Guppy as chief engineer. Mr. Guppy had full charge of the construction work in Oakland, Alameda and Berkeley, upon which was expended more than $11,000,000 during the past three years.

PROGRESS AT THE PANAMA-PACIFIC EXPOSITION GROUNDS.

Thus far Oregon, Nevada, Washington, Montana, Idaho, Utah, South Dakota, Philippine Islands, Missouri, Hawaii, Nebraska, Kentucky and Illinois have selected sites for their States' participation in the 1915 Universal Exposition. On July 5th, Pennsylvania and Arizona were added to this list. Twenty-nine States have appointed Commissioners to come here and select sites. Compared with other expositions, this showing is considered remarkable. Japan will be the first foreign country to select its site the latter part of July. Canada's representative is also authorized to select a site for that country's participation.

DEFINITIONS GIVEN BY RATE RESEARCH COMMITTEE.

1—**Flat Rate**—The term **Flat Rate** is applicable to any method of charge for (gas or) electric service which is based on the consumer's installation of energy-consuming devices or on a fixed sum per consumer, irrespective of the quantity used. Meters are not used.

2—**Demand Rate**—The term **Demand Rate** is applicable to any method of charge for (gas or) electric service which is based on the maximum demand during a given period of time. The demand is expressed in such units as kilowatt or horsepower (or rate of flow of gas). Maximum-demand indicators or graphic meters are used.

3—**Meter Rate**—The term **Meter Rate** is applicable to any method of charge for (gas or) electric service which is based on the amount used. This amount is expressed in such units as kilowatt-hours of electricity (or cubic feet of gas). Integrating meters or graphic meters are used.

4—**Consumer's Output Rate**—The term **Consumer's Output Rate** is applicable to any method of charge for (gas or) electricity service based on the consumer's output. The unit of the consumer's output may, for example, be a gallon of water pumped, a barrel of flour, or a ton of ice made, etc.

5—**Two-Charge Rate**—The term **Two-Charge Rate** is applicable to any method of charge for (gas or) electric service in which the price per unit of metered (gas or) electric energy for each bill period is based upon both the actual or assumed quantity of (gas or) electric energy consumed and the actual or assumed capacity or demand of the installation. (Example—The Hopkins Rate.)

6—**Three-Charge Rate**—The term **Three-Charge Rate** is applicable to any method of charge for (gas or) electric service in which the charge made to the consumer for each bill period consists of (a) a sum based on the quantity of (gas or) electric energy consumed, (b) a sum based upon the actual or assumed capacity or demand of the installation, (c) a charge per consumer. (Example—The Doherty Rate.)

7—**Straight Line**—The term **Straight Line** as used in connection with and as applied to any method of charge indicates that the price charged per unit is constant, i.e., does not vary on account of any increased or decreased number of units. The total sum to be charged is obtained by multiplying the total number of units by the price per unit.

8—**Block**—The term **Block** as used in connection with and as applied to any method of charge indicates that a certain specified price per unit charged for all or any part of a block of such units and reduced prices per unit are charged for all or any part of succeeding blocks of the same or a different number of such units, each such reduced price per unit applying only to a particular block or portion thereof. The total sum to be charged is obtained by multiplying the number of units in the first block by the price per unit for that block and adding thereto the number of units in the second block times the price per unit for that block, and so on until the sum of the units falling within the different blocks equals the number of units to be charged for.

WESTERN LAWS OF ELECTRICITY AND WATER

THE DESERT LAND ACT AND THE CAREY ACT.

BY. A. E. CHANDLER.

The Desert Land Act.

When the arid public lands were first occupied and irrigated there was no act providing for their alienation other than the homestead and pre-emption acts, both passed in 1862. The first act to specially provide for the conditions of the irrigation states was the desert land act of March 3, 1877, which, slightly amended, is still in force. The only public land and irrigation states in which the act is not operative are Kansas and Nebraska.

Only desert lands are subject to entry and it has been held that the following lands are not desert: Lands which produce native grasses sufficient to make an ordinary crop of hay in usual seasons; lands which will, without irrigation, produce a reasonably remunerative crop of any kind; lands bearing a natural growth of trees.

As entry may be made by any citizen, twenty-one years of age, a woman, married or single, is entitled to do so. Under the original act, one section, or 640 acres, was the limit of entry, but by the act of March 3, 1891, it was restricted to 320 acres.

To make entry an application must be filed at the local land office, showing that applicant is a citizen, or has declared his intention to become such; that he is 21 years of age or over; that he is a bona fide resident of the State in which the land lies; that he has not previously made desert land entry or taken an assignment of such; that he has not since August 30, 1890, acquired title to nor is claiming under any of the agricultural lands laws, including the lands applied for, lands which in the aggregate exceed 320 acres; and that he intends to reclaim the lands described in the application through irrigation within four years.

The act of March 3, 1891, provided for the assignment of the entire entry, but the act of March 28, 1908, allows an assignment in whole or in part—except that not less than a 40-acre subdivision can be assigned. The latter act forbids the assignment of an entry to a corporation or an association.

With the application a map must be filed showing the proposed method of irrigating the land described, and a payment of 25 cents per acre must be made. Before the end of each of the first three years after entry proof must be filed at the local land office showing the expenditure of one dollar per acre during the year. This "annual proof" must be sworn to and must be corroborated by the affidavits of two reputable witnesses. Expenditures for ditches, dams, fences, roads, the first breaking of the soil, barns and other stock buildings, and wells for irrigation purposes, will be allowed. Expenditures for stock in an irrigation company to furnish water to land entered will also be allowed.

The entryman, or his assignee, is allowed four years from date of entry to satisfy the requirements of the act, but he may make final proof and receive patent as soon as he has expended three dollars per acre, has reclaimed all the irrigable land included in his entry, and has cultivated one-eighth of the entire area entered. When possible under the state laws, the final proof must show an absolute water right for the irrigation of the land entered. Up to six years ago the Department was very lax in passing upon final proofs, but under the present regulations a rigid examination is made of the water right and the extent of irrigation and cultivation. At the time of making final proof a payment of one dollar per acre must be made.

As there is no residence requirement in the desert land act other than to reside in the state and as payment for the land itself is only $1.25 per acre, the act has been very popular. In the past many irrigation companies secured large areas of public land by stipulating with entrymen to furnish water right and take in return one-half or more of the land entered. Such contracts were illegal and under the present vigilance are not tolerated. It is allowable, however, in contracting with an irrigation company for a water right for a desert entry to stipulate that on default of the specified cash payment the entryman shall deed to the company a portion, or all, of the land entered. It is evident that the permissible contract may result in the same end as the prohibited contract, but, on its face at least, it is not an agreement to convey.

In the few states, like California, which have not accepted the provisions of the Carey act, the desert land act is the best method of securing the settlement of public lands under a private irrigation project.

The Carey Act.

In the last article reference was made to the many failures of private irrigation companies organized to irrigate public land—the principal cause for which being the inability of the company to restrain "sooners" or mere speculators from entering the land, and to secure a sufficient lien, upon such land as subscribed for water rights, for nonpayment of annual charges. To relieve this situation Congress in 1894 passed the so-called "Carey Act"—named after Senator Carey of Wyoming, who introduced it.

The act authorized the Secretary of the Interior, with the approval of the President, to contract with each state having desert lands for the free grant to the state of not exceeding one million acres of such lands "as the state may cause to be irrigated, reclaimed, occupied, and not less than twenty acres of each one hundred and sixty-acre tract cultivated by actual settlers, within ten years after the passage of this act." Before any segregation of land was allowed, the state had to file a map of the land and the plan proposed for its irrigation. As satisfactory proof, according to the regulations of the Secretary of the Interior, was made by the state "that any of said lands are irrigated, reclaimed, and occupied by actual settlers, patents shall be issued to the state or its assigns for said lands so reclaimed and settled: Provided, That said states shall not sell or dispose of more than one hundred and sixty acres of said lands to any one person."

The original act was a great step in advance in that it allowed the segregation of all the public lands under an irrigation project and thus precluded the

earlier type of speculator, but it failed to provide for a lien in case of nonpayment of water right charges. The act of June 11, 1896, met this need by authorizing liens to be created by the state for the actual cost of reclamation and reasonable interest, and by providing that patents shall issue to the state, without regard to settlement or cultivation, as soon as a proper irrigation system and ample water supply are furnished. It is specifically provided in this amendatory act that the United States shall in no way be liable for such lien, or any part thereof.

As stated above, the original act provided that the lands segregated must be reclaimed as specified within ten years after the passage of the act. No change was made in this severe requirement until the act of March 3, 1901, which provided that the ten years' period "shall begin to run from the date of approval by the Secretary of the Interior of the State's application for the segregation of such lands." It further authorizes the Secretary of the Interior in his discretion to grant an extension not exceeding five years.

The original act applied only to states. The act of February 18, 1909, extended the provisions of the act to the territories of Arizona and New Mexico. The act of March 15, 1910, authorized the Secretary of the Interior to temporarily withdraw from entry areas embracing lands for which a state proposes to make application, pending the investigation and survey preliminary to the filing of the regular application for the segregation.

The Secretary of the Interior has prepared regulations which must be followed by the states in making Carey act segregations. No segregation is now approved until examined on the ground and reported favorably by a government engineer. This course has been criticized by some as reflecting upon the states, but as the government is the owner of the land it should not be asked to grant such until all the conditions precedent thereto have been fulfilled to the satisfaction of its representatives. The following statement from the annual report of the Commissioner of the General Land Office for 1911 is in point:

> The importance of this (the examination of projects) can not be overstated, for not only will the lands remain segregated for a long period of time, if the order therefor is once made, but in making such segregation the department is practically committed to the feasibility of the proposition submitted by the state, and people thereafter dealing with the state are in a great degree entitled to regard the proposition of the state as having received the endorsement of the department.

The provisions of the Carey act have been accepted by Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, South Dakota, Utah, Washington and Wyoming. During the fiscal year ending June 30th, 1911, 3,193,314 acres were segregated to the states. The total area patented under the act up to June 30, 1911, is 388,404 acres. The present activity in such projects is shown by the following statement by the Commissioner of the General Land Office (Annual Report, 1911):

> A conservative estimate would indicate that there will be 4,000,000 acres included in segregation lists for Carey act projects during the coming year (1911-1912). During the last fiscal year 1,650,000 acres of selections were examined. There have been withdrawn for exploration and survey under the act of March 15, 1910, 3,500,000 acres.

State Legislation.

Idaho and Wyoming were especially active in preparing for development under the Carey act. There was close co-operation between the officials of the two states and their original legislation in this regard was practically the same, and, as amended from time to time, has served as a model for the other states.

Under the special state legislation the operation of the Carey act as far as the state is concerned is entrusted to a board. The irrigation project is not constructed by the state, but by an individual, association or company contracting with the state through the board. To initiate the enterprise the contractor files with the board a request for the withdrawal or segregation of the desired tract of desert public land and a proposal to construct the irrigation system, stating the source of water supply, the location and dimensions of the proposed works, the estimated cost of construction, and the price and terms at which perpetual water rights will be sold. The request must be accompanied by a certificate of the state engineer showing that the contractor has made proper application to appropriate the necessary water. A certified check of specified amount must be deposited with the board as a guarantee that the contractor will execute a contract with the state in case the segregation is made.

The state engineer is required to report on the feasibility of the scheme, and if his report be favorable the board applies to the Secretary of the Interior for the segregation of the desired tract. If granted, the board and the contractor execute an agreement which includes complete plans and specifications regarding the execution of the proposed work, and specifies the price, terms, and conditions under which water rights (carrying a proportional part of the system) will be sold to settlers. The contractor must furnish a bond, of amount prescribed by statute or regulation of board, as a guaranty of faithful performance of contract.

As soon as the segregation has been made and work initiated by the contractor on a proper basis, the board must publish notice stating that the lands segregated are open for settlement and the price which must be paid to the state for the land and to the contractor for the water right. Any one intending to settle within the project must first execute a water right contract with the contractor for the tract upon which he intends to file. He then applies to the board for the tract, and if successful secures a certificate of location on payment of one-half the price of the land fixed by the state. He must establish his residence on the tract within six months after water is ready for delivery and must cultivate at least one-sixteenth of the land entered during the first year and at least one-eighth during the second year. He must make final proof within three years and complete his payment to the state. The latter payment is generally only fifty cents—twenty-five cents to be paid on entry and twenty-five cents on final proof. The statutes provide for the control of the system being given to the water users thereunder, but the condition precedent thereto varies greatly. Idaho gives control when 35 per cent of the total lien has been satisfied, while South Dakota leaves the control with the contractor until 90 per cent of the land has been sold. In Oregon the system must be turned over to the settlers within ten years.

Development Under the Carey Act.

The data for the following statistical statement of the work accomplished in the various states under the Carey act was taken from the last biennial reports (1909-1910) of the land or Carey act boards and of the state engineers. It was assembled by Mr. A. P. Stover, of Irrigation Investigations of the United States Department of Agriculture, in his very comprehensive paper entitled "Irrigation Under the Carey Act," published in the Annual Report of the Office of Experiment Stations for the year ending June 30, 1910. The data, with the exception of the area granted, is for the close of 1910.

Colorado.—The total area granted to the state, not including the Ute Indian Reservation grant, is 1,000,000 acres; the total area segregated, contracted and applied for was 1,121,940 acres; the area of reclaimed land sold to settlers was 34,000 acres; the number of projects being developed was 20; and the cost of water rights ranged from $15 to $45 per acre.

Idaho.—The total area granted to the state is 3,000,000 acres (2,000,000 acres having been added by Congress in 1908); the total area segregated was 2,630,833 acres; the area of reclaimed land sold to settlers was 270,184 acres; the number of projects being developed was 42; and the cost of water rights ranged from $20 to $100 per acre, with an average of $28 per acre.

Montana.—The total area granted to the state is 1,000,000 acres ;the total area segregated was 411,326 acres; the area of reclaimed land sold to settlers was 45,000 acres; and the number of projects being developed was 13.

Nevada.—The total area granted to the state is 1,000,000 acres; the total area segregated was 173,215 acres; and the number of projects being developed or investigated was 13.

Oregon.—The total area granted to the state is 1,000,000 acres; the total area segregated was 593,124 acres; the number of projects being developed was 16; and the cost of water rights ranged from $10 to $60 per acre.

Wyoming.—The total area granted to the state is 2,000,000 acres (1,000,000 acres having been added by Congress in 1908); the total area segregated was 1,390,365 acres; the area of reclaimed land sold to settlers was 130,000 acres; the number of projects being developed was 63; and the cost of water rights ranged from $10 to $65 per acre, with an average of $15 per acre.

Practically nothing had been done under the Carey act at the close of 1910 in New Mexico, South Dakota, or Washington. In Utah ten projects were being examined and one had reached the construction stage. Water right charges up to $250 per acre are proposed in Utah. It must be remembered that the maximum water right charge is fixed in the contract with the state, so that the state officials are to blame if excessive charges are allowed. The aim ordinarily is to give the contractor a good profit and at the same time to protect the settler. In Oregon the practice has been to fix the maximum charge at "the actual cost of construction plus seventy-five to one hundred per cent profit, to reimburse him for the risk, cost of selling and other necessary expenses in addition to the usual construction cost."

DEFINITIONS OF SOME IMPORTANT TERMS.

Due to the rapid rise of the electrical industry and the evolution of the art many new words have crept into our language. The various engineering societies are grappling with the problem and gradually the confusion of tongues is subsiding. The National Electric Light Association has adopted the following definitions of important terms:

Capacity Factor—The ratio of the highest experienced load for a specific interval of time to the maximum capacity for this same interval.

Example—A station whose highest average load during one hour has been 8000 kw., and whose maximum capacity for the same interval, one hour, is 10,000 kw., would have a capacity factor of .... $\frac{8000}{10,000}$ =80 per cent

Note—The interval over which load is integrated should be the same as the interval on which maximum capacity is based. This interval may be momentary, or five minutes, or one hour, etc., but should be stated in giving capacity factor. It will be seen that capacity factor cannot be greater than unity, and the difference between the capacity factor and unity is the margin available for growth, spare capacity, or emergency.

Demand—Demand is a load specified, contracted for, or used, expressed in terms of power, as kilowatt or horsepower.

Note—The interval of time considered should be specified.

Diversity Factor—The ratio between the simultaneous demand of a number of individual services for a specified period, such as one hour, and the sum of the individual maximum demands of those services for the same period.

Note—Diversity factor is expressed in per cent, and can never be greater than unity unless expressed in terms of its reciprocal.

Effective Demand—The demand at the time of the system's maximum load.

Note—This can be applied to an individual customer, feeder, or station.

Example—If the maximum demand occurs on an electric system at 5 p. m. December 20th, the effective demand by an individual service would be the demand of that service at the hour mentioned.

Feeder—An electric circuit used to supply power to a subsidiary distributing system.

Instantaneous Value—The value of varying quantity at a particular instant, as distinguished from a value averaged over a finite length of time.

Note—The instantaneous value is the absolute value at any instant as given by oscillograph record.

Indicated Value—The value of a varying quantity as indicated by an instrument which averages the instantaneous values.

Note—Indicated values are given by common ammeters, voltmeters and other electrical instruments, as they average the values of sine wave or fluctuating current, due to their inertia or dead-beat qualities.

Indicated Peak—A peak load as given by an indicating instrument.

PHOTOGRAPHY IN ENGINEERING

BY M. R. LOTT.

Manipulation.

The different processes which are undergone in the production of a finished picture may be stated as follows. These are given in their natural order:

1. Exposure of plate.
2. Development of plate.
3. Fixing plate.
4. Washing plate.
5. Drying plate.
6. Retouching plate.
7. Printing negative.
8. Developing print.
9. Fixing print.
10. Washing print.
11. Drying print.
12. Mounting print.

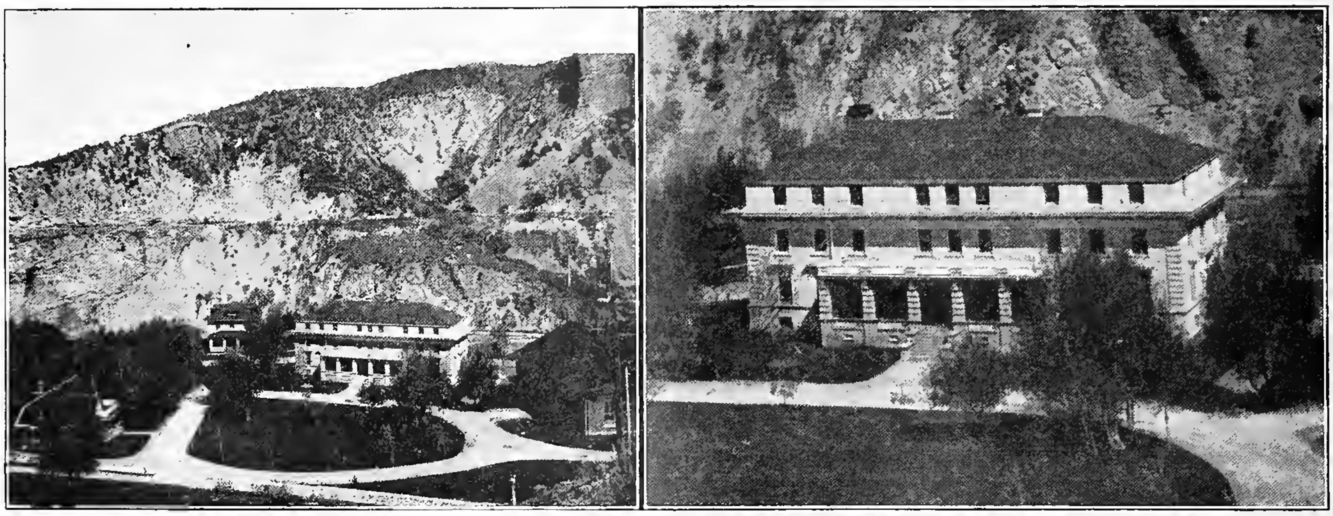
Normal conditions will be treated first, then abnormal ones with methods for correcting them. Later on the making of bromide enlargements will be discussed, and finally formulas recommended for performing the work will be given, accompanied by brief discussions of their properties.

kind of weather have a great influence on the time length of exposure, the intensity of light under ordinary conditions being much greater at noon than at any other time of the day. The quality of the light varies with the season.

Varying the opening of the diaphragm changes the amount of light entering the camera and consequently affects the length of exposure. There are two systems for indicating the size of opening of the diaphragm. the one most commonly used being the U. S., or uniform system, which gives the following exposures in terms of the exposure for the largest stop as unity:

1, 2, 4, 8, 16, 32, 64, 128, 256.

The smaller the opening used the sharper will be the image, but for ordinary purposes stop 64 gives satisfaction.



A Photograph With Bromide Enlargement at the Right

Dry Plates and Their Exposure.

Briefly stated, a dry plate consists of a film of gelatin containing silver bromide and iodide mounted upon one side of a glass plate.

The operation of loading a plate holder is carried on in the developing room, using only the ruby light previously described for illumination. Care should be taken to see that the plate holder is free from dust before the plate is inserted. The emulsion side of the plate is towards the lens when placed in the camera. This surface should be lightly brushed with a camel's hair brush, about 2 in. wide, after the plate has been placed in the holder, to remove any dust that may be present. If this precaution is not observed, small transparent spots will appear on the negative when it is developed.

There are four main conditions which govern the length of exposure of a plate:

1. The character of the light illuminating the object to be photographed.
2. The opening of the diaphragm.
3. The object to be photographed.
4. The sensitiveness of the plate used.

The altitude of the sun, the time of year, and the

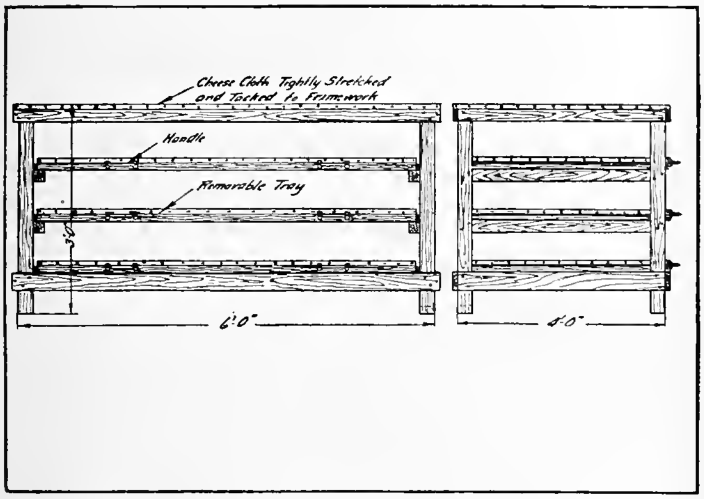
There is usually a great difference in the lengths of exposure required for photographs of drawings taken by reflected light and photographs of tracings taken by transmitted light, the latter requiring much the less time.

Plates are made with different degrees of sensitiveness according to the class of work for which they are intended to be used. For taking photographs of drawings and tracings, Cramer's Contrast plates give excellent results, 10 in. by 12 in. being a convenient size to use, as the prints may then be trimmed down to 8½ in. by 11 in. (letter paper size) for binding with reports, etc.

Experience in judging the actinic qualities of the light is the best means to use for deciding upon the correct exposure to be given a plate, though there are various devices for aiding a person not experienced in the work. Among these may be mentioned Wynne's Infallible Exposure Meter. This device depends upon the time required for its sensitized paper to assume the shade of a standard color. Scales are given which give the time of exposure for different stops and for plates of the various manufacturers.

Exposures of the plate should be accomplished by removing the lens cap.

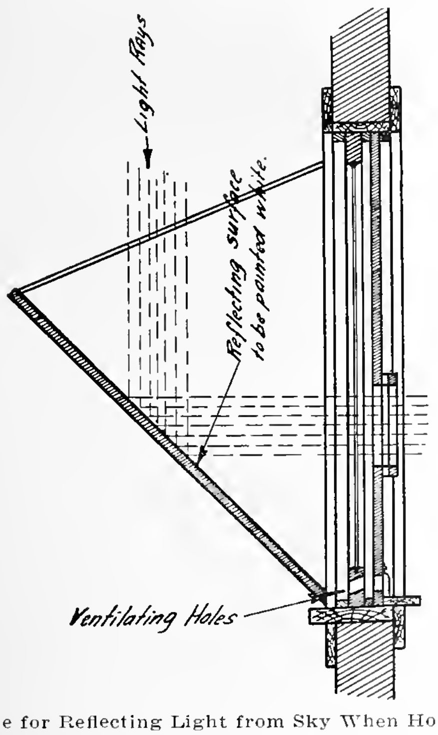
Dry plates have the quality known as "latitude," this characteristic permitting different lengths of exposure, still preserving the proper gradations of density that is, still possessing the proper exposure. This property varies with different brands of plates.



Drying Rack for Prints.

Development.

The exact effect of the rays of light upon the plate is unknown, but whatever the composition formed may be, the action of the developer is to reduce it to metallic silver. There are numerous agents used for accomplishing this result. A developer must include three agents, one to act as a reducer, one as an accelerator, and one as a preservative.



Device for Reflecting Light from Sky When Horizon Is Obscured.

The reduction to metallic silver means that bromine is set free. The water in the solution furnishes the hydrogen for the necessary reaction. This reaction necessitates the presence of some substance with which the oxygen may combine.

Alkalies, such as sodium or potassium carbonate, accelerate the reduction by increasing the affinity of the developing agent for oxygen. Sulphite of soda also seeks oxygen and its presence in the developer governs the action of the developing agent and prevents its oxidation till development is accomplished.

When a plate is developed, it should be first wet in water before being placed in the solution in order to insure an even flow of developer over its surface. Development should take place with the film side of the plate up and during the process the film should be shielded from the ruby light as much as possible.

The kind of developer to be used depends upon the purpose for which the negative is made. When great contrast transparent high lights and dense shadows is desired, such as is required in photographs of drawings Cramer's X-Ray Developer (formula given later) is unexcelled. For photographs of machinery and engineering structure, where detail is essential, Eastman's Pyro Developer or an adaptation of Eastman's M. Q. Developer (formulas given later) gives excellent results.

Given a correctly exposed plate, the high lights will appear first during development and these will be followed by the half tones, and then by the shadows. The longer the time of development, the greater the strength secured until the strongest high light is visible on the back of the plate. Ordinarily this takes place when a plate has been developed until no image is apparent when held up to the ruby light for the purpose of looking through. When this stage has been reached development should cease.

After a plate has been in the developer a short time it is possible to determine whether the exposure has been correct or not. If a plate has been over-exposed, the image appears simultaneously all over as soon as the action of the developer takes place, while in the case of under-exposure development takes place slowly. Over-exposure tends to destroy contrast but its effects may be greatly remedied by the method of handling. A few drops of a 10 per cent solution of potassium bromide added to the developer as soon as over-exposure is apparent will restrain the action of the developer, thereby giving more time for the details in the shadows to be brought out. Development in this case will last long enough to bring out the detail. If the negative is too dense it may be reduced afterwards by use of the reducing solution discussed later. An under-exposed plate can not be helped much, but if it is not possible for it to be retaken, matters may be remedied a little by removing the plate from the dedeveloper and placing, without rinsing, in clear water for a short time and then back to some fresh developer. In case of over-exposure, the amount of developing agent should be increased according to the degree of over-exposure, and for under-exposure more carbonate of soda should be used.

The printing qualities of a thin negative may be improved by the use of the intensifying solution given later. A developer too strong or too warm will tend to produce a chemical fog unless a few drops of potassium bromide are added to the developer.

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POWER AND GAS

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Railway Electrification at Portland

As first announced in these columns two weeks ago, R. T. Guppy, who had complete supervision of the construction work of the Southern Pacific's Alameda county electrification, has been placed in full charge as chief engineer in the electrification of the Southern Pacific lines out of Portland. On another page of this issue will be found fuller details of this proposed gigantic electrification.

The Southern Pacific Company now has 900 single-track miles in electric operation in Southern California and 100 miles in the cities on the east side of San Francisco Bay. In addition to this, the city lines in Riverside, Redlands, San Bernardino, Colton, Fresno, Stockton, San Jose and the Peninsular electric system, between San Jose and San Francisco are owned and operated by the Southern Pacific Company. The operation of traction lines is, then, not a new subject to the executives of this great system. Indeed the miles and miles of electric traction lines owned by the Spokane Inland, Vallejo Northern, Northern Electric, Oregon Electric and other systems of the West have long since emphasized the substantial permanency of this mode of conveyance.

It is doubtful if any single thing has been so potent in the development of Southern California for instance as that resulting from the world famous network of interurban and suburban electric lines in that section of the Golden State. A rancher living among the orange groves enjoys all the sweet quiet and wholesome life of the country and yet within an hour's time, if he so desires, he may be whisked into the center of the great southwestern metropolis—Los Angeles. The produce of the farm, too, has become far more directly transported to the centers of consumption. Indeed these two features, now recognized as infallibly resulting from electrification have caused thousands of acres to be settled by high class intensive ranchers and have made rural life in Southern California a by-word of contentment and happy boosting.

With the proposed electrification of the Willamette Valley, such will inevitably be the happy destiny of that productive community. A destiny bright in future promise for those interested in Portland and the future of her rural districts. Nothing builds a city quicker than the substantial growth in population and in productiveness of her surrounding territory.

This new move on the part of the Harriman lines has another interesting and even deeper phase attached to it. One more link is added to the chain of coast long electrification. The problem of electrifying the transcontinental railroad has been a long and seriously discussed one without complete solution to date. In summing up the evidence, however, the greatest argument against it seems to be a host of "doubting Thomases," reared from childhood upon the steam propelled idea. They proclaim opposition until they can see a transcontinental line electrically operated and rest their eyes upon the dividend side of the resulting ledger accounts. Until such time as this nothing may be expected from them.

The West has ever been willing to exploit new ideas and make good. This new move of the Southern Pacific Company merits the heartiest support from all concerned.

Hydroelectric Developments

The recent N. E. L. A. convention at Seattle did much for the West. No small credit for the superb boosting of western enterprise and progress is due to the beautiful special issues of the great eastern electrical journals brought forth and distributed among the hundreds of delegates to this convention. The Electrical World of this particular issue, for instance, resembled in size and expert material an unabridged encyclopedia of western hydroelectric projects.

In the editorial of the issue referred to, however, entitled "Hydroelectric Developments," appeared the following:

"It is remarkable that already the water power utilized in the Western States of California, Colorado, Idaho, Montana, Oregon and Washington is collectively nearly half of the total power available in the waterfalls of those States, according to the recent reports of the Commissioner of Corporations. In the Eastern States the water power already harnessed bears a much smaller ratio to the total available power."

This statement appearing in the editorial columns of such high authority caused considerable comment and surprise at the convention among hydro-electric men who are familiar with the enormous potentialities of undeveloped water power in the west. On another page of this Journal will be found a summary of the water powers of the United States taken from the commissioners' report referred to. Below is the actual report in figures of the states referred to:

	Undeveloped Min.	Undeveloped Max.	Developed or under construction.	Undeveloped but owned by companies now actually generating hydro-electric power.
California	3,424,000	7,818,000	435,467	732,749
Colorado	842,000	1,697,000	69,690	59,000
Idaho	1,162,000	2,567,000	52,100	42,300
Montana	2,749,000	4,331,000	139,260	105,700
Oregon	3,148,000	6,613,000	95,777	143,600
Washington	4,932,000	8,647,000	300,510	115,700
	16,257,000	31,673,000	1,092,804	1,199,049

Thus, the minimum western water power in these states as given by the commissioner is seen to be 16,257,000 while that actually developed or under construction is given as 1,092,804, which is seen to be not quite 7 per cent of the total—far different from "nearly half." In other words only a beginning has been made. Possibly the writer referred to mistook the column shown above to the right giving the total of 1,199,049 as the total undeveloped horsepower. This is not clear to us, however, at least so far as California is concerned, for under a tabulation on page 1195 of the Electrical World purporting to set forth comparative line data on transmission systems, there is omitted all reference in the tabulation to the Pacific Gas & Electric Company of central California, the greatest hydroelectric net-work in the world. By reference to the commissioner's report, it is seen that the column totaling 1,199,049 horsepower bears positively no relation to the total power resources of these states, for, as shown, it is simply a statement from the power companies now actually generating hydroelectric power as to what water powers they themselves still control though in the undeveloped state. This column for instance makes no attempt at summarizing the powers owned by hundreds of western hydroelectric companies still in the embryo, nor does it total the powers still in possession of the federal states or the federal government. The total minimum column of 16,257,000 h.p. does, however, after boiling down the former report of the U. S. G. S. and allowing for all reasonable factors, give a conservative estimate of undeveloped western water power.

Again, we challenge the statement that in the eastern states the water power already harnessed bears a much smaller ratio to the total available power than in the western states. Let us once more refer to the commissioner's report, taking the most conservative figures there to be found, that under the "minimum" heading.

	Minimum possible power.	Developed or under construction.
North Atlantic States	2,225,000	1,515,992
South Atlantic States	2,344,000	496,504
North Central States	1,733,000	737,180
South Central States	1,438,000	78,450
Other than Western	....	12,097
	7,760,000	2,840,223
Western States	18,996,000	1,175,904

Thus, it is seen that in the western states a total of 1,175,904 horsepower are now developed from a possible minimum of 18,996,000, while in the eastern states 2,840,223 are developed from a possible minimum of 7,760,000. In a word, 36.6 per cent of possible water powers are even now developed in the eastern states as opposed to only 6.2 per cent in the western states.

Some difference!!!

Relief Associations

A feature emblematic of the human sentiment embodied in the present day attitude of the executives of the leading public utility companies is that looking toward the financial protection of employes in times of sickness and in times of death. Indeed, the whole trend in public utility success under the commission regulating regime is toward development of loyalty among the rank and file of those administering the affairs of the public utility, for success is achieved nowadays largely in living up to the commandment of the modern Moses—"The public be pleased." Teamwork, then, seems to be the keynote to success.

The old adage, speaking of the friend in need, never uttered truer saying. The good things of life seem largely composed of emotions brought to consciousness in times of need or human suffering. Such emotions imbue us with loyalty and appreciation seldom brought about under less trying circumstances. The wide-awake public utility company is not asleep or indifferent to this truism. On another page of this issue appears the constitution and by-laws of a relief association recently promoted and put into successful operation by the Western States Gas & Electric Company, which maintains its headquarters at Stockton, California.

The idea merits the profoundest consideration of all public utility corporations. In many cases departures will of necessity have to be made in applying to other companies and conditions the details as set forth in the constitution and by-laws referred to. The main idea—mutual help and benefit—developed along practical lines will do more than anything else, however, in developing true loyalty to public utility interests.

PERSONALS.

Waldema Chirakoff, of Moscow, Russia, is inspecting Pacific Coast irrigation systems.

George J. Henry Jr. has returned to San Francisco after visiting Montana in conection with hydraulic engineering work.

E. B. Walthal, assistant general manager of the San Joaquin Light & Power Corporation, is a recent San Francisco visitor.

C. L. Cory, consulting engineer, left Berkeley on Saturday, together with Mrs. Cory, for an outing in Yosemite Valley.

L. E. Strothman, manager of the pumping engine department of the Allis-Chalmers Company, of Milwaukee, is at San Francisco.

A. E. Griswold of the A. G. Electric & Manufacturing Company, San Francisco, was in Seattle recently looking after the interests of the "A. G." products.

J. B. Lukes, representative of the Stone & Webster Engineering Corporation, has returned to his headquarters at San Francisco after visiting Denver.

M. W. Wuesthoff, Pacific Coast representative of the Glauber Brass Manufacturing Company of Cleveland, Ohio, is among the recent arrivals at San Francisco.

C. Z. Czarnecki, a recent graduate of the electrical engineering department of the University of California, is with the Great Western Power Co. in their Napa division.

Franklin Schwabacher, secretary of the Floriston Pulp & Paper Co., and an associate member of the A. I. E. E., has returned to San Francisco from a trip to Sonora, Mexico.

E. E. Gilbert, manager of the turbine sales department of the General Electric Company, is on his way to Schenectady, via Chicago, after spending several weeks on the Pacific Coast.

O. E. Barlow, the Pacific Northwest district manager for the American Ever-Ready Company, recently visited the company's Factory No. 8 at San Francisco, under the supervision of President R. F. Oakes.

A. E. Chandler, secretary of the American Engineering Corporation of San Francisco, has left for Humboldt, Nevada, where he is retained by the Pacific Reclamation Company as water right expert.

George I. Kinney, manager of the San Francisco office of the Fort Wayne Electric Works, returned during the week from a short vacation trip. He reports good prospects in the electric drill department of the business.

Y. Sakai, for eight years in the engineering staff of the Westinghouse Manufacturing Co. at East Pittsburg, left San Francisco Saturday on the steamer Nippon Maru for Tokyo, Japan, where he expects to open up consulting engineering offices.

A. E. Rowe, sales manager of the Telephone Electric Equipment Company, has just left for an extensive tour of Southern California. He will be at San Jose during the annual convention of the State Electrical Contractors' Association late in July.

Sidney Sprout, supervising engineer for the California-Oregon Power Company, returned to San Francisco during the past week, after visiting the company's dam site on the Klamath River, where work will be pushed as soon as the water is a little lower.

B. S. Josselyn, president of the Portland Railway, Light & Power Company of Portland, Ore., in recognition of his five years' service with the company, was recently presented with a gold stripe arm band, resembling that worn by the company's motormen and conductors.

John A. Britton, general manager of the Pacific Gas & Electric Company, J. H. Wise, his assistant, and George C. Holbertson, San Francisco district manager, made an insepction of the extension work in progress at Lake Spaulding, Placer County, during the past week.

C. H. Holley, general manager of the Tulare County Power Company, and **Fred Hamilton**, superintendent at Visalia for the Mount Whitney Power and Electric Corporation, were at San Francisco during the recent hearing involving the two corporations fefore the Railroad Commission.

John Bray, assistant treasurer of the Western Electric Company, has arrived at San Francisco from New York and is visiting F. B. Gleason, manager of the Pacific Coast department of the company. Mr. Bray won second honors in the mile run at the Olympic games at Paris in 1900.

A. W. Bullard, general manager of the Great Western Power Company, and **P. T. Hanscom**, his general superintendent, have returned to San Francisco after spending several days inspecting the new work in progress at the Las Plumas power station and at the site of the new dam at Big Meadows.

John F. Gilchrist, assistant to the president of the Commonwealth Edison Electric Company of Chicago, is a recent arrival at San Francisco. He is an ex-president of the National Electric Light Association and is the right hand man of Samuel Insull, who is now heavily interested in the Pacific Gas & Electric Company.

R. Leo Van der Naillen, general manager of the Oro Electric Corporation, which has been given permission by the Railway Commission to install a hydroelectric transmission system in Plumas County, will visit the power site during the coming week, with a view to commencing work as soon as conditions will permit.

ELECTRICAL DEVELOPMENT LEAGUE.

The semi-annual business meeting of the Electrical Development League was held at Tait's Cafe in San Francisco at the regular monthly meeting time, Tuesday, July 9, 1912. The affairs of the league were shown to be in excellent condition. W. L. Goodwin, chairman of the membership committee, reported 141 members enrolled with no resignations to date.

The following officers were elected: President, H. B. Carter; vice-president, A. W. Bullard; executive committee, Wynn Meredith, Geo. C. Holberton.

Chas. Gilchrist, recent president of the National Electric Light Association Convention at Seattle, was guest of honor and spoke in the highest complimentary terms of the great part the Electrical Development League had played both in entertaining the delegates to the convention and in the favorable impression created on all sides by sending the Golden Poppy Special to the Seattle Convention.

MEETING NOTICE.

The sixth annual convention of the Illuminating Engineering Society will be held at the Hotel Clifton, Niagara Falls, Ontario, September 16 to 19. The program of papers that is being arranged includes a number of notable papers which embody the results of some recent photic investigations. There will also be a potpourrie on miscellaneous phases of illuminating engineering.

ELECTRICAL JOBBERS' MEETING.

The next meeting of the Electrical Supply Jobbers' Association of the Pacific Coast will be held at Lake Tahoe, August 22, 23 and 24, 1912. The committee will arrange tennis, billiards, bowling and pool matches, besides which there will be fishing, swimming and a steamer trip around the lake. Reservations may be made through A. H. Elliott, 34 Ellis street, San Francisco.

ELECTRICAL CONTRACTORS' NOTES.

W. D. Thomas, an electrical supply dealer and contractor, of Petaluma, has been visiting San Francisco.

M. McConnell, an electrical contractor of Santa Rosa, has been spending a few days at San Francisco.

Arthur Kempson has been appointed assistant chief of the Department of Electricity at a salary of $200 a month, having been promoted from the position of superintendent of outside construction. For the first time a liberal budget has been adopted which will give Chief William J. Nixon enough men and resources to carry on the work of the department as it should be. Electrical contractors will now be able to get their work inspected promptly and avoid delays in securing payment for their work.

LAST CALL FOR EXCURSION TO CALIFORNIA CONTRACTORS' CONVENTION.

BY W. S. HANBRIDGE.

With the returns coming in from our many electrical friends we can assure you that there will be a very large crowd at San Jose during the entire convention.

"Something doing every minute" is our motto.

Don't forget that there are special rates on both the Santa Fe and the Southern Pacific Railroad. When you buy your ticket, get a one-way ticket with a receipt certificate, which, when signed by the secretary, will entitle you to a return ticket for one-third fare.

The going tickets are good up to and including July 27th and will be placed on sale on and after July 15th. The return tickets on sale on and after July 24th and are good up to and including August 1st. Stop-over privileges will be allowed going, but not returning.

The St. James Hotel has been selected at headquarters.

The arrangements for the program have been completed and there will be plenty of fun; good chances to get acquainted with one another, and last but not least, special attention has been paid to the educational program.

Come yourself and bring the family. Come in your every day clothes, so you can have a good time.

A copy of the program has been sent you, but lest you forget, we will repeat:

Wednesday, July 24th, 10:00 a. m.—Business meeting; members only. 1:30 p. m.—Ladies and visitors sight-seeing auto trip to Congress Springs, returning by way of Los Gatos. 8:00 p. m.—Reception, concert, dancing and through the kindness of the Westinghouse and General Electric Company an illustrated lecture will be given.

Thursday, July 25th: 10:00 a. m. and 2:00 p. m.—Business meeting, members only. 11:00 a. m.—Sight-seeing trip to Palo Alto through the foothills, via Interurban Special train. A lunch will be served the visitors by the Chamber of Commerce of Palo Alto. After lunch the ladies and visitors will be given an auto sight-seeing trip through the mountains, while the members will hold a session in the National Guard Armory. In the evening, a theatre party.

Friday, July 26th: 10:00 a. m.—Open meeting for all who attend. Mr. H. V. MacMeans, of the Southwestern Surety Insurance Company, will explain the Rosebury Act and how rates are arrived at for liability insurance. Mr. C. W. Mitchell, inspecting engineer of the Board of Fire Underwriters, will read a paper on the Underwriters' Rules. Mr. Milton Wise, publicity manager of the Great Western Power Company, will read a paper on the Development of the Electrical Business by Advertising. W. S. Hanbridge will talk on "Methods of Estimating and what should be done to protect same."

Recess.

2:00 p. m.—Open meeting. Mr. Tracy Bibbins will read a paper on "How the Manufacturer and Contractor can assist one another in the general uplifting of their business." Mr. Geo. Holberton, of the Pacific Gas & Electric Company, will tell us what we should know about the commercial end of the central station, at the same time showing pictures of their plants. Mr. Charles Hillis, of the Electric Appliance Company, will tell us of the "Wits of the Contracting Business and how to correct same, from the eyes of a Jobber." Last, our old friend Mr. Albert Elliott, will make a final talk on "Co-operation among the electrical trades."

As the above will not interest the ladies, there will be a sight-seeing auto trip to Alum Rock Canyon for them.

In the evening at 8:00 p. m. sharp, we will sit down to the annual dinner. Plenty of entertainers have been provided. Host Bettins has arranged a fine menu. Strictly informal.

The inspectors from the different cities in California; also representatives from Oregon and Washington Electrical Contractors' Association, who will return from Denver National Convention with our delegates, will attend as our guests.

Saturday, July 27, will be Electrical Trades Day. Leaving the St. James Hotel at 9:00 a. m. we will proceed to Luna Park. As soon as a game can be called the Northern and Southern Contractors will lock horns for the baseball championship of the coast.

Good music for dancing will be provided.

A good lunch will also be provided.

After lunch, the following contests will be held:

100-yard dash for men; 50-yard dash for ladies; 100-yard dash for members; 25-yard dash for ladies over 160 lbs.; 50-yard dash for girls under 16 years; 100-yard dash for boys under 16 years; 50-yard dash for children under 7 years; 25-yard dash for babies under 4 years; 50-yard dash for fat men.

Gate prize drawing.

Ball game between Supply men and Contractors, for a cup.

Golf contest—for Electrical Supply men only.

Season tickets for non-members can be obtained from Contractors at $5.00 each.

For the benefit of our friends who can only get away for Electrical Trades Day, tickets will be sold at the park entrance at $1.00 each. Banquet $2.50 each. Sight-seeing trips $1.00 each. Theatre party $1.00 each.

The following are the committees:

Committee of Arrangements—L. R. Boynton, N. Hope, L. G. Ames, L. Levy, W. S. Hanbridge.

Finance Committee—F. Somers, H. Tittle, F. Watts, W. S. Hanbridge.

Reception Committee—C. Faser, F. Somers, R. A. Warner, J. Gilbert.

Ladies' Reception Committee—Mrs. Chas. Faser, Mrs. F. Somers, Mrs. R. A. Warner, Mrs. L. R. Boynton, Mrs. L. G. Ames, Mrs. P. Levy, Mrs. W. S. Hanbridge.

Entertainment of Ladies and Visitors—P. Levy, J. Foster, R. A. Warner, C. Anthony, J. Gilbert.

Annual Dinner Committee—P. Decker, N. Hope, F. Somers.

Picnic Committee—Seth Cohn, L. G. Ames, Chas. Faser.

Prize Committee—L. Levy, L. R. Boynton, H. Reed, C. Eppstein, G. Davis, W. Kohlwey, G. Peters, M. Fortini.

Music and Printing—C. Faser, L. R. Boynton, W. S. Hanbridge.

Transportation and Hotel—W. Kirsten, G. Sitman, W. S. Hanbridge.

Convention Papers—C. F. Butte, P. C. Butte, L. Levy, W. Gallavin.

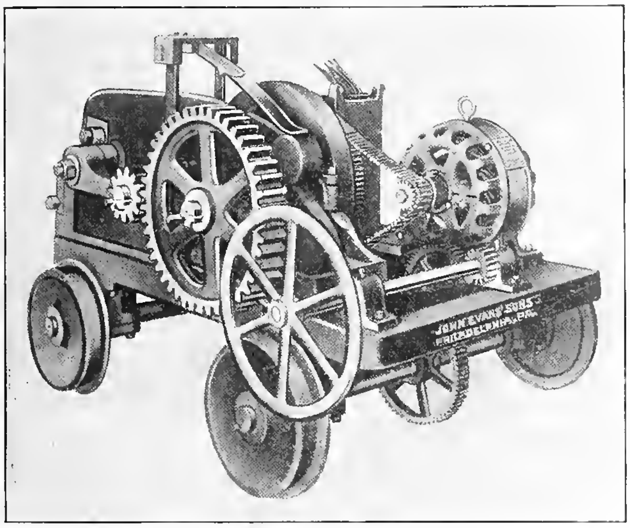
The Electrical Development League at its meeting held Tuesday, July 9th, 1912, passed a resolution and appointed a committee to secure one or more special cars to take their members, who were unable to attend the convention on account of business, to San Jose, leaving San Francisco, Third and Townsend streets, at 9:00 a. m. Saturday morning, July 27th, 1912.

It has been decided to hold a Sons of Jove Rejuvenation on the evening of Saturday, July 27th, and it is expected to be one of the events of the convention.

INDUSTRIAL

A PORTABLE SHEAR, MOTOR OPERATED.

A novel motor application is shown in the accompanying illustration of a John Evans' Sons' shear mounted with its driving motor on a small flat car. The places where this machine may find a use are limited, but it is a very valuable adjunct to wholesale hardware houses, factory storerooms, railroad shops, or in any place where metal bar or strap is handled.



Shear Mounted on Flat Car.

The car is designed for standard gauge track, being propelled by the hand wheel. The car is run along on track, in front of the bins containing the material, to any particular point where the required lengths of the desired material are cut.

The shear motor is of Westinghouse make, 7½ horsepower, operating on three-phase alternating current. The current is conveyed to the motor by means of a long flexible cable, or, when used over a track of any length, a number of junction boxes for making connections to the motor is more satisfactory.

TRADE NOTES.

Pass & Seymour, Inc., of Solway, N. Y., have opened Pacific Coast sales offices in the Rialto Bldg., San Francisco, in charge of W. Brewster Hall, Pacific Coast sales manager.

Charles C. Moore & Company, through their Seattle office, were awarded the contract by the government to furnish a Harrisburg, 4-valve, 120 horsepower engine at Fort Casey. The engine is to be direct connected to generator, for supplying light and power.

The Great Western Power Company's general offices have been removed from the Shreve Building to 227-233 Post street, where an entire six-story building is occupied. The sixth floor, which will be occupied by General Manager Bullard, will be practically one large office, with only a few glass partitions.

The Stimson Mill Company, Seattle, Wash., which recently contracted for a complete electrical power plant equipment, has arranged for motor drive throughout its mills and placed an order with the General Electric Company for thirty-three motors ranging from 5 to 300 h.p. with necessary controlling apparatus.

The Coast Range Lumber Company, Mabel, Ore., will soon install equipment for electric motor drive consisting of four motors of 10 h.p., two of 35 h.p., one of 25 h.p. and two of 50 h.p.; also a 75 kw. turbo generator and switchboard. The order for the apparatus has been placed with the General Electric Company.

The General Electric Company has sold the following apparatus: To the Standard Oil Company for installation at Richmond, Cal., five multi-stage centrifugal compressors, each consisting of one T. 3, 5555, 8, 4, 3900 r.p.m. compressor, driven by a 245-h.p. Curtis steam turbine, aranged for operation on 80 lbs. steam pressure, 27 inches vacuum.

W. L. Goodwin, general manager of the Pacific States Electric Company, announces that plans have been adopted for a six-story and basement building that will be completed by November 15th, for their exclusive use. The building will be erected on the south side of Mission street, east of Second, at an estimated cost of $80,000. The Mission-street front will be faced with pressed brick, terra cotta and tile, and there will be a rear frontage on Minna street. Automatic sprinklers, pneumatic tubes, two elevators and two high-speed electric hoists will render the building safe and convenient for the electrical supply business.

NEW CATALOGS.

The Electric Storage Battery Company has just issued bulletin No. 136 on storage batteries for railway cars. Illustrations are given of typical installations.

The Century Electric Company of St. Louis has just issued Bulletin No. 18 on single-phase, self-starting motors. The bulletin sets forth in a neat and attractive manner a description of the various motors manufactured by the company and illustrates their application in the industries.

Bulletin No. 4880, recently issued by the General Electric Company, describes that company's Signal Volt-Ammeter, known as the Type S-2. The instrument is used for testing direct current railway signal apparatus. Bulletin No. 4925 describes its Combined Unit Mercury Arc Rectifier Outfit. This outfit consists of the constant current transformer, direct current reactance, tube tank and exciting transformer mounted on a common base. Bulletin No. 4950, describes the Washington, Baltimore & Annapolis 1200 Volt Direct Current Railroad. This has now been operating as a 1200 volt road for over two years. Bulletin No. 4952, is devoted to a description of the Series Incandescent Street Lighting System as furnished by that company.

BOOK REVIEW.

Electrical Injuries, Their Causation, Prevention and Treatment.—By Chas. A. Lauffer, A.M., M.D. Size 4¼x6½ in.; 77 pages; cloth binding. Published by John Wiley & Sons of New York, and for sale by the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price 50 cents.

This booklet is designed for the use of practical electrical men. The author is the medical director of the relief department of the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa. Nation-wide interest has been manifested by electrical men in precautions leading to prevention of accidents, but particularly has this interest shown itself in the way of individuals so preparing themselves that effectual aid may be rendered comrades in the soul-harrowing scenes accompanying the electrical shock. This booklet first deals in the various electrical injuries that may arise; then follow notes on minor surgery and first aid. The last two discussions on infections and the effects of occupation on the health are particularly to the point. The booklet should find a ready welcome among those exposed to electric shocks.

NEWS NOTES

ILLUMINATION.

TACOMA, WASH.—The plant of the Tacoma Gas Company was damaged to the extent of $2000 in a recent fire.

HELENA, MONT.—A move is under way, fostered by the commercial club, to install electroliers in the business district.

LOS ANGELES, CAL.—Bids will be received up to July 26 for furnishing the city electrical equipment, according to specifications thereof.

SPOKANE, WASH.—The Spokane Gas Company proposes to give Hillyard a service by a $50,000 extension, if franchise can be secured.

ARTESIA, N. M.—The Artesia Light & Power Company has advertised for bids for installation of the first unit of a series of additions to the local plant.

LOST HILLS, CAL.—The San Joaquin Light & Power Company has finished connecting up the new line into the Lost Hills and electric lights and power are now available.

GLENDORA, CAL.—At a meeting of the City Council a resolution was passed providing for installation of a system of electric lights to illuminate the business section of town.

LOS ANGELES, CAL.—The substation of the Southern California Edison Company, located at Ninth street and the river has been destroyed by fire. The loss is estimated at about $10,000.

CITY OF MEXICO, MEX.—Contracts have been entered into by the Vera Cruz Electric Light, Power & Traction Company for a supply of power from the Puebla Tramway, Light & Power Company.

PORTLAND, ORE.—The franchise sought by the Northwestern Electric Company asking permission to operate in this city a plant for furnishing heat, light and power to consumers has been referred to the street commission of the executive board for fixing the valuation.

HOOD RIVER, ORE.—"Our company will develop 1500 horsepower by the completion of the big new flume that has been begun from the rapids of Hermann Creek," says G. A. Young, president of the Columbia River Power & Light Company, who was here on business. "We have been serving the citizens of Cascade Locks, near which our plant is located, with electric lights since last Thanksgiving by means of a temporary system we constructed. It is probable that within a short time some business enterprise will come to Cascade Locks and make use of the surplus power we are developing. Several companies are now considering our offer." The other officers of the newly-incorporated company are: M. Collins, manager, and R. W. Lang, secretary.

TELEPHONE AND TELEGRAPH.

ALBION, WASH.—The Pacific States Telephone Company has petitioned the council of Albion for a franchise to install a switchboard in the city.

COLFAX, CAL.—The Colfax Suburban Telephone Company has made arrangements for improvements of its system and to increase the efficiency of the service.

TAMPICO, MEXICO.—A concession has been applied for by John B. Body, managing director of S. Pearson & Sons, for the construction of a wireless telegraph station here.

SPOKANE, WASH.—The Inland Telephone & Telegraph Company with head offices in Spokane, commences this week the construction of long distance lines in the Inland Empire.

NORTH BEND, ORE.—R. P. Kehoe states that he and others are making preparations to build a modern telephone line in North Bend and that a franchise will be applied for immediately.

CLOVIS, N. M.—The equipment force of the Mountain States Telephone & Telegraph Company is enlarging the offices, adding to exchanges and otherwise improving the system at this place.

SOUTH PASADENA, CAL.—Bids will be received up to August 19, for a franchise to maintain for forty years, telephone and telegraph lines over and along the public streets and highways of said city.

SOUTH PASADENA, CAL.—A franchise has been granted the Home Telephone Company to construct telephone and telegraph wires for a period of 40 years. The grantee shall commence to build the system within 30 days.

LEWISTON, IDAHO.—The Inland Telephone & Telegraph Company will invade the Lewiston territory by the construction of lines between Spokane and Lewiston where connection will be made with the Nezperce Co-operative Telephone Company. The total cost of the line to be constructed will be approximately $125,000.

PASADENA, CAL.—Plant Engineer W. D. Moore considers that the two systems—the Pacific Telephone & Telegraph Company and the Home Telephone & Telegraph Company—are so nearly equal in size that it will be impossible to throw them into one exchange. Temporary connection must be established by placing cables from the Pacific office to the Home office. The cost will be $25,000.

OAKLAND, CAL.—Better telephone service was promised by officials of the Pacific States Telephone & Telegraph Company at a meeting of the City Council during the rate fixing investigation. It was practically decided that the rates now in force should continue in effect. Harry Brownlee, manager of the company, in response to a statement by Commissioner of Public Works Harry S. Anderson to the effect that the service of the telephone company had deteriorated, admitted that the acquirement of the Bay Cities Home Telephone Company's plant had overloaded the exchanges of the Sunset telephone service. Brownlee promised that within two weeks the service of the Pacific corporation would be raised to a higher standard.

SAN FRANCISCO, CAL.—The gross revenue of the Pacific Telephone & Telegraph Company for May was $1,505,493, compared with $1,257,477 for the corresponding month of 1911, an increase of $248,016. Net earnings for the month were $379,551, compared with $279,429 for May, 1911, an increase of $100,122. For the five months ended May 31, 1912, net earnings were $1,666,717 as against $1,369,658 for the first months of 1911, a gain of $297,059. This is an increase in net earnings of about 21 per cent for the five months. The company has been showing a steady increase in gross revenue for a number of years, the gross for 1911 being $16,070,112 against $7,884,071 in 1905. The company owns and controls the entire Bell telephone business on the Pacific Coast. The territory served is rapidly increasing in population and wealth and much larger earnings are confidently expected. Its territory includes such important and growing cities as San Francisco, Los Angeles, Seattle, Portland, Tacoma and Spokane, together with every other important city and town in the States of California, Washington and Oregon.

SAN FRANCISCO, CAL.—The Pacific Telephone & Telegraph Company has filed a complaint with the Railroad Commission against the Sierra & San Francisco Power Company. The complaint concerns the new power line which the Sierra company is constructing from a point near Coyote in Santa Clara County to Kings City in Monterey County. The telephone company charges that this high-tension power line will parallel its telephone line for a distance of approximately 46 miles in such close proximity as to interfere seriously with the operation of the telephone line. The telephone company contends that the power line paralleling its own line at an

average distance of 55 to 67 feet for 46 miles will interfere through induction and through disturbing elements to such an extent that the telephone line will be rendered unusable for the transmission of messages. It is stated further that the proximity of the power line will subject the employes of the telephone company to danger from electrical shocks and will endanger its property from fire caused by the undue current. The telephone company requests, therefore, that the Railroad Commission issue an order directing that the power line be constructed at least 1000 feet from the telephone line, and in such manner as will protect its employes and its property.

TRANSPORTATION.

SEATTLE, WASH.—The Supreme Court in a written opinion holds that the $800,000 bond issue for the construction of the municipal car line is legal.

VANCOUVER, WASH.—It seems certain that the proposed extension of the electric line from Sifton to Hockinson will be made soon. The necessary money can be secured.

LOS ANGELES, CAL.—Within three months two new branches of Pacific Electric lines will be completed connecting Los Angeles with San Fernando and Owensmouth via Van Nuys.

WARRENTON, ORE.—This place will probably grant a franchise to Geo. A. Robinson for an electric car line, who proposes to do considerable work of this nature in this vicinity.

COLTON, CAL.—Application has been made for a franchise granting the right to construct an electric railroad upon certain highways of Colton. Bids will be received up to July 31.

CHICO, CAL.—The train service on the Hamilton City branch of the Northern Electric road has been discontinued until about August 10 on account of the tearing up of the track for street improvements.

NAMPA, IDAHO.—Final arrangements for the work of constructing the 14 miles extension of the Idaho Traction Company line between Caldwell and Roswell have been finished, and work is about ready to start.

WEST VANCOUVER, B. C.—The council has ordered the B. C. Electric Railway to immediately start work on the construction of its electric line in this city, otherwise the franchise granted it some time ago will be canceled.

LOS ANGELES, CAL.—The Santa Fe Railroad is preparing to expend $10,000 for block signals in Southern California; to build and equip the electric generating plant to supply current to work automatic signals, the sum of $200,000 has been asked for by Coast Line officials.

VANCOUVER, B. C.—It is announced here that MacKenzie & Mann, of the Canadian Northern Railway, have secured control of the entire holdings (14 companies) of the Dominion Power & Transmission Company for a consideration bordering on $25,000,000. It is not known yet what changes are contemplated.

SACRAMENTO, CAL.—The Board of Supervisors passed an ordinance granting to the Oakland, Antioch & Eastern Railway a franchise to join in the construction, maintenance, use and operation of a certain combination railroad, wagon-road and foot passenger bridge across the Sacramento River from the foot of M street in the city of Sacramento.

VANCOUVER, B. C.—The International Railway & Development Company, capitalized at $50,000,000 English capital, has been organized to build numerous electric lines through lower B. C. The company will build a large dam across the Fraser River for the production of power. D. M. McDull is the company engineer. A plant to produce 100,000 h.p. is contemplated. The construction of an electric line from New Westminster to Ladner is contemplated and another from Ladner to this place.

SAN FRANCISCO, CAL.—A resolution introduced by Supervisor Vogelsang directing the Board of Works to give estimates of the cost and submit plans for extensions of the Geary street road from Kearny street to the outer tracks in Market street, opposite Sansome, and from Thirty-third avenue to the beach was passed. Vogelsang explained that this resolution would pave the way for these extensions and would also place all in readiness for the extension of the municipal railway down Market street to the ferry.

ASTORIA, ORE.—The town councils of Warrenton and New Astoria at special meetings held recently, passed ordinances granting George A. Robinson, a 30-year franchise for an electric railroad running through both towns. Each of the measures provides that the grantee shall pay a license of $100 a year, shall accept the franchise within 60 days and shall deposit $250 as a forfeit that he will begin construction within 90 days and will have the road to Seaside completed and in operation within one year.

VALLEJO, CAL.—The Vallejo & Northern Railroad will concentrate all its energies upon the construction of the division from Vallejo to Sacramento upon the completion of the Sacramento-Woodland divisions. This was the statement of President T. T. C. Gregory following a meeting by the board of directors, at which there were present President Gregory, Directors Ernest Holly, William Pierce and John W. Bauman of Suisun and W. R. Morden of Dixon, with Attorney Goodell of San Francisco. Work on the Vallejo-Sacramento division will be pushed from both ends.

SACRAMENTO, CAL.—T. T. C. Gregory, president of the Vallejo & Northern Railroad, has notified J. F. Barry, grand jury expert, that he will not permit an examination of the books on the ground that the grand jury has no right to go into the private affairs of electric companies. The idea of the proposed examination of accounts was to find out exactly what the cost of the M street bridge is. President Gregory has placed the cost at $380,000, while it is asserted testimony given at a trial of condemnation suit in Woodland recently the cost of the bridge was given as $270,000.

TRANSMISSION.

GREENVILLE, CAL.—Contracts have been let by the Droege Mining Company, composed of the Swedish syndicate, including E. O. Lindbloom, Linderbereger and others, for the furnishing of electric power by the Indian Valley Electric Light & Power Company. The power will be available for the Droege and other mines within two months. A temporary steam plant will be installed as an auxiliary to the present hydroelectric plant at Greenville. The steam plant will develop 200 h.p. It is expected, within a few months, to have Senaca power in the district from the Seneca plant to be built on the north fork of the Feather River by the company.

SAN FRANCISCO, CAL.—Permission has been given the Pacific Gas & Electric Company by the Railroad Commission to construct two new hydroelectric plants on the Bear River in Placer County, and build a power line from them to a point near Crockett on San Francisco Bay. The company will install four 10,000 kw. generators, and later increase the output to 100,000 kw., the power thus generated taking the place of that now purchased from the Great Western Power Company. About $5,000,000 will be required for the installation of the first 40,000—capacity and construction of the power line. The commission stated that it will probably now be necessary for the company to apply to the commission for permission to issue some of the stocks and bonds by the sale of which, according to a plan mapped out last year, the work will be financed.

SAN FRANCISCO, CAL.—The State Railroad Commission has issued an order granting for the most part the Oro Electric Corporation's application to extend its transmission lines

across the Sacramento Valley and the upper San Joaquin Valley into Alameda and Contra Costa Counties. The permission was based upon the condition that the bonds of the Oro Electric Corporation, now held by affiliated companies, be sold only with the consent of the commission. The utility proposes to extend its power lines now through Plumas, Butte, Yuba, Sutter, Colusa, Glenn, Yolo, Solano, Contra Costa, Sacramento, Calaveras, San Joaquin and Alameda counties. Incidentally, the corporation has agreed to reduce its Oroville rate, according to the commisson. When the Oro Electric applied for a certificate of necessity and convenience to extend its lines it encountered opposition from the Pacific Gas & Electric Company, the Western States Gas & Electric Company, the Northern California Power Company and the Vacaville Water & Light Company, all of which asked that the Oro be kept from their territory. The Oro's affiliated corporations are the Oro Water, Light & Power Company and the Oro Development Company.

WATERWORKS.

EL CENTRO, CAL.—An election will be called soon when the proposition of voting $40,000 bonds for extending the city water system will be voted upon.

SOUTH PASADENA, CAL.—Voters are to be asked to provide the necessary bonds at once to secure sewers, water and fire protection, roads and other public utilities.

PORTLAND, ORE.—The House has passed the Senate bill authorizing the sale to the city of Pendleton of 200 acres of Umatilla reservation lands for water supply purposes.

SAN DIEGO, CAL.—A call for a bond election to raise funds for the purchase of the entire water system has been issued by the City Trustees. The plan is to operate the system as a municipal project.

FULLERTON, CAL.—The City Attorney has been instructed to draw up a resolution of intention to call an election for issuance of $80,000 of bonds for the construction of a municipal waterworks system.

BURLINGAME, CAL.—Experts retained by the Board of Trustees have reported in favor of the municipal water system. It will cost $175,000 and it is the purpose of the Board to bond the city for this amount.

SPOKANE, WASH.—The Elk City Mines corporation, operating the South Fork property on the Clearwater river in the Elk City district, will spend between $10,000 and $15,000 in installing a water power plant this summer.

GLENDALE, CAL.—The matter of establishing a municipal water system is being thoroughly considered. It is estimated that if the city bond itself for the sum of about $300,000 it will be possible to secure various systems now supplying the city.

REDLANDS, CAL.—A committee recommends that the City Trustees offer the Domestic Water Company the sum of $165,000 for entire water plant, except the gravity water and Citrus avenue property, and that the sale offer remain open until August 1.

LAS VEGAS, N. M.—The Augua Pura Company is engaged in the construction of a long canal to be used as an inlet for a new reservoir in Peterson canyon and is also contemplating other improvements. A new contract for furnishing water to the city may be signed.

HILLSBORO, ORE.—The Washington-Oregon Corporation has been unanimously granted a franchise to lay its pipes from Sain Creek to Hillsboro, in and across the county roads. The company's first offer was for a maximum of 35,000 gallons, but the board held for 50,000 and this was accepted on the part of the water people.

MILWAUKIO, ORE.—At an adjourned meeting of the Council a petition was received asking that a special election be called in September to vote on an issue of bonds up to $40,000 with which to establish a city water plant by purchasing of the present waterworks or construction of new works.

HOOD RIVER, ORE.—At the meeting of the Council a resolution was passed authorizing the advertisement for the sale of $36,000 water bonds; the sum is to be used in caring for the warrants issued in payment of the water system secured from the Pacific Power & Light Company through condemnation proceedings.

RIVERSIDE, CAL.—The City Council has entered into an agreement with the firm of Burns & McDonnell, hydraulic engineers of Kansas City, for an investigation of local water systems, with a view to securing recommendations for needed extensions and improvements, and the amount that would be needed to be raised by a bond issue to convert these plants into a municipal system.

HOOD RIVER, ORE.—Citizens of Underwood plan on beginning work soon on a water system to supply the homes of the entire vicinity. They have filed on the water of Moss Creek for this purpose. The expense of laying mains will be taken care of by a bond issue. Funds have already been provided for preliminary work and a hydraulic engineer will soon be on the ground to make surveys.

HONOLULU, H. T.—The Department of Public Works will now turn its attention to the waterworks, and with the flotation of the new bond issue will expend over a quarter of million dollars. Superintendent Campbell announces that with the approval of the bond issue tenders for new pumps and other machinery will be called for at once in order to call the bids before the department as soon as the money is available. The exact sum to be spent on the waterworks will be $265,000.

ESCONDIDO, CAL.—The City Trustees have adopted a resolution to sign a tentative agreement submitted by the directors of the Mutual Water Company for a better water supply. The agreement contemplates the purchase by the city of all distributing mains and the city reservoir, and improvement on same, the expense of both to be borne by a bond issue. It also provides for the company building an additional reservoir or raising of the present one, located seven miles east of the city.

LAKEPORT, CAL.—The Yolo County Water & Power Company has recorded here a lengthy document placing in trust with the Oakland Bank of Savings their interests in the waters of Clear Lake and the lands bordering them, preparatory to starting the sale of a $10,000,000 bond issue in bonds of the denomination of $1000 each. The action of the company creating the trust is presumably for the purpose of raising funds to carry out their project for impounding the waters of the lake for irrigation and power purposes. The title which the company has to any of the water or land of the lake is in dispute and it is stated by Attorney H. E. Witherspoon, who represents D. W. Shetler, the party opposing the Yolo company in the Lake litigation, that before the company can lawfully sell any bonds, it must prove title to the lake property and rights involved.

SAN FRANCISCO, CAL.—Reports to Chief Engineer Murphy from officers of the fire department in regard to the lack of sufficient pressure in many hydrants have been filed with the Supervisors. Battalion Chief Grote reported that very little water was obtainable from the hydrants on Geary street, at Thirty-ninth and Fortieth avenues, on June 16, when a building there burned down. One of the hydrants was abandoned as useless, and only a small stream could be got from the other. Capt. Geo. R. Lawson reported that on June 19 no water could be got from the hydrant on Rhode Island street, between Eighteenth and Nineteenth, and his company could do nothing. A fire on that date proved very disastrous. Henry Rice, former hydrant man, reported that the hydrant at Leavenworth and Francisco streets, had been dry for some time, the water not reaching it because of the lowness of the reservoir at Francisco and Bay streets. Chief Murphy also gives a long list of hydrants throughout the city where the water pressure is low.

ALPHABETICAL INDEX TO ADVERTISERS

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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Where to Buy It in the West, Pages 9, 10, 12 | Alphabetical Index to Advertisers, Page 8.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

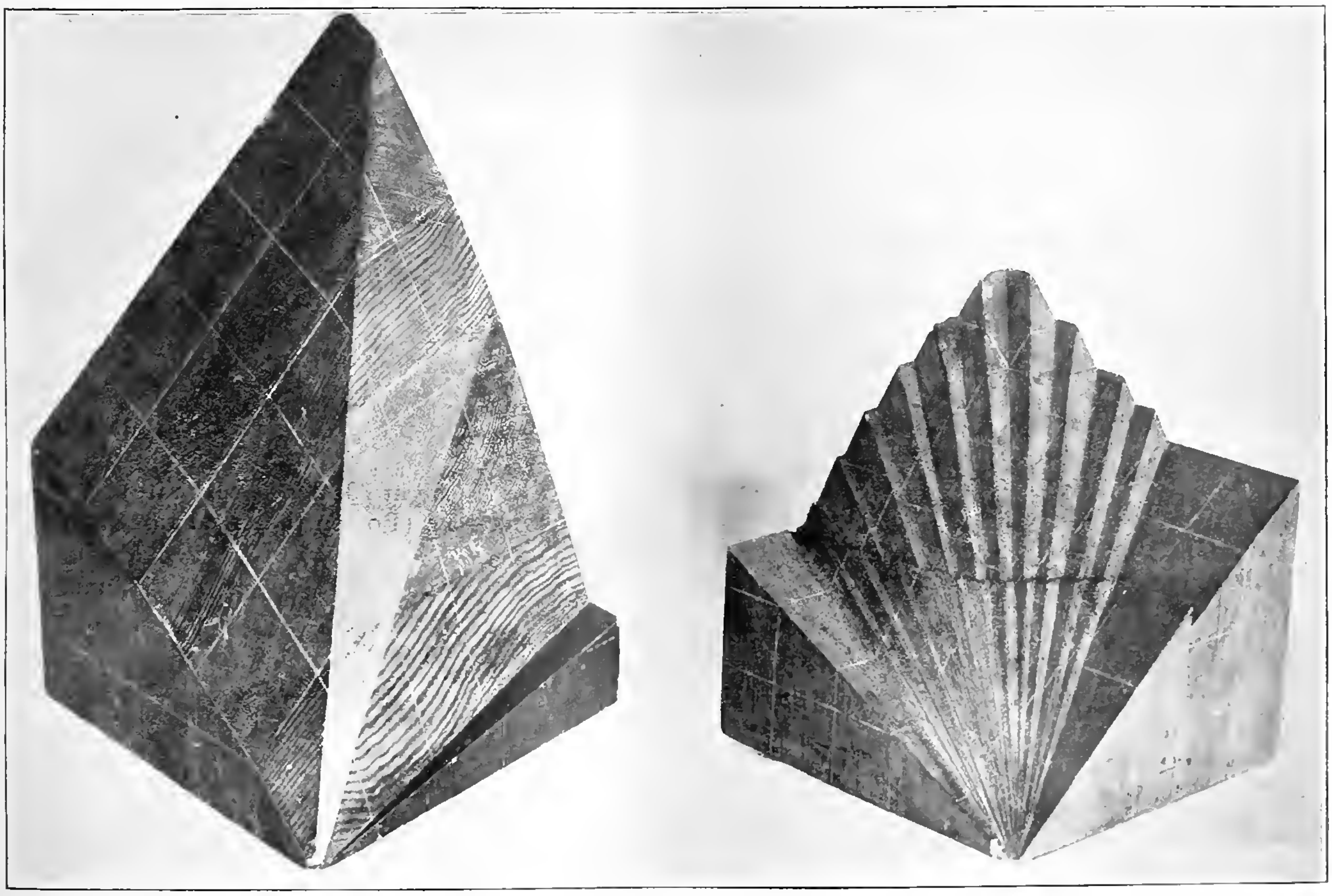
VOLUME XXIX SAN FRANCISCO, JULY 20, 1912 NUMBER 3

GRAPHIC REPRESENTATION OF ELECTRIC RATES[1]

BY H. E. EISENMENGER.

The basis of all rates for electric service, as well as the basis for the price of all other goods and services, is the cost of producing the same.

Some of the men who are giving their attention to the theory of rates contend that this ought to be the only basis of rates, whereas others maintain that the "value of service" to the customer should enter into rate making also in such a way that a larger percentage of profit should be involved in the rates for such customers to whom the electric service is of greater value, either for the reason that they derive financial benefit from it (money earning applications of electric motors, business lighting, etc.) or for the reason that money is of less value to them. On the other hand, customers who are in the position to construct and run a private plant of their own should be offered a rate with a smaller profit.



A Graphical Representation of a Celebrated Rate Determination.

Similar principles are acknowledged in price-making of other business; for instance, a theatre charges more for the front seats, simply because they are valued higher by the patrons than the back seats, although they cause exactly the same expenses. If the same price would be charged for all seats, the back

[1]The principles of rate analysis and geometrical representation as explained in this paper have been first published by the author in the First Report of the Rate Research Committee of the National Electric Light Association (1911), and then in the Electrical World of November 4, 1911. This paper contains several new aspects and instructive examples, and was read before the Portland Section of the A. I. E. E., May 21, 1912.

seats would have to be raised in price in order to obtain the same income, and thus a number of poorer theatre-goers would be deprived of the possibility to see the play. To quote another example, a physician may charge his wealthier clients more for the same service, and a minister will expect a higher marriage fee from a richer man. Railways give lower excursion fares in order to reach customers which either do not value the pleasure of the trip sufficiently, or to whom money is worth too much to pay the regular fare, etc. The railway is thus increasing the volume of their business and their earnings, and this may contribute its share towards the possibility of the lowering of the regular rates. Whichever of the two principles we adopt, the rates must always be based on the cost of service to the central station, to which we add a certain percentage of profit, which under the "cost of service" principle is a constant, and under the "value of service" principle will vary between classes of customers.

The cost of service depends on a very large number of factors. The rate maker finds himself in a dilemma, as on the one hand the rates shall follow the cost to each individual customer as closely as possible, and on the other hand, the rates shall be as simple as possible. We have to make a compromise between these two contradictory postulates, and this is done in almost all existent rate systems by considering not more than the following three of the cost determining factors.

1. One item of expense which is constant for every customer, whether they are large or small.

2. One item which is proportionate to the customers' maximum demand d in kw. Instead of measuring the maximum demand, in many instances some equivalent for the same is taken; for instance, the connected load, the number of sockets connected, and in some modern rates the floor area to be illuminated or the number of rooms (in residences).

3. One item proportionate to the energy consumption in kw. hrs.

There are other items which influence the cost of service to the customer; for instance, the distance from the central station, the character of distribution lines in the part of the city occupied by the customer's premises (underground or overhead), the customer's diversity factor, etc., but all these factors are averaged for each schedule into the three above mentioned ones. If we would try to take them all into account, the schedule would become hopelessly complicated.

This system is called the three-charge system, and in its simplest form would have, for instance, the following shape:

Each customer is charged a fixed amount of 50c per month, and, besides, $3.00 every month for each kw. connected; moreover, he has to pay 2c for each kw. hr. consumed. The first amount (50c in this example) is called the customer charge or connection charge; the second ($3.00) the demand charge, and the third one (2c) the kw. hr. charge.

It will be shown later that this direct way of expressing the three charges is not the only one. In many cases other ways of expressing these rates are preferred, which disguise the three-charge rate to a certain degree.

Calling now

a=The amount of an individual customer's monthly bill in cents.

d=His maximum demand in kw. (or connected load or sockets, floor area, etc., as specified by the rate).

e=His monthly energy consumption in kw. hrs.

x=The customer charge per month in cents.

y=The demand charge in cents per kw. maximum demand of connected load (sockets, 1000 sq. ft., rooms, etc.) per month.

z=The kw. hr. charge in cents per kw. hr.

We have then $a = x + dy + ez$, where in the above example

x= 50c
y=300c
z= 2c

a, d and e are the variables.

Special cases are frequently used where one or two of the three values, x, y, z, are O. For example, if x and y are O, we have a straight kw. hr. rate (for instance 10c per kw. hr.); if x and z are O the rate changes to a straight kw. flat rate (for instance, $5 per month for each kw. connected); y=O would be represented for instance by the so-called "Theatrical rate" in Boston, charging each customer on that schedule $180 per month, and besides, 3c for each kw. hr. consumed, etc.

The rate schedule is nothing else but an instruction how to figure the bill for any given number of kw. (sockets, rooms, etc.) and kw. hrs.; in other words, it gives the customer's bill as a function of the maximum demand d, and the kw. hr. consumption e, and can therefore be expressed in the shape of a mathematical formula $a=f(d, e)$. For instance,

$a=50+300\,d+2\,e$ (Three-charge rate of the above example)

or $a=10\,e$ (Straight 10c per kw.-hr. rate)

or $a=18000+3\,e$ (Boston theatrical rate), etc.

Every engineer is aware of the usefulness of graphical representation of all kinds of functions of variables, and in thoroughly investigating the nature of a given system of electric service rates, comparing them with other rates, etc., graphical methods are almost indispensable.

Since we have three variables—a, d, e—we have to use three dimensions, which is best done in the following way:

First choose a plane system of rectangular co-ordinates D and E, Fig. 1, with the customer's demand d stepped off on the D axis, and his energy consumption e on the E axis. Each customer is then represented by a certain point p, giving his individual maximum demand d and his energy consumption e. If we connect p with the origin of co-ordinates O, the connection line O p includes an angle λ with the axis of D, where tan λ is proportional to the load factor L.

Since $L = \frac{e}{d}$, it is obvious that a load factor of 100 per cent is not represented by an angle of 90 deg., but

by a smaller one, the size of which depends on the relation of the scales of d and e. We thus get an angle λ_{100} the vector O V, which is determined, for instance, by the point d = 1 kw., and e = 730 kw.-hrs. (730 = number of hours in a month). That part of the area which is beyond the vector O V (shaded area) has no meaning in practice.

Stepping off now the third variable a, the amount of the customer's bill, normal to the horizontal plane D E upwards into space, Fig. 2, we get for each customer a point in space P where p P is the amount of the respective customer's bill under the system of rates under consideration.

If we pass a plane through P and the axis of D, this plane includes an angle δ with the horizontal D E plane, Fig. 2, and $\tan \delta = \frac{a}{e}$ = average price per kw.-hr. and similarly $\tan \alpha = \frac{a}{d}$ equals the average price per kw.

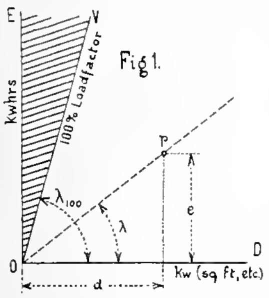
If we now step off the corresponding length p P for every point p, all these points P together will form a surface which is the geometrical representation of the function a = f (d, e) and therefore also of the rate.

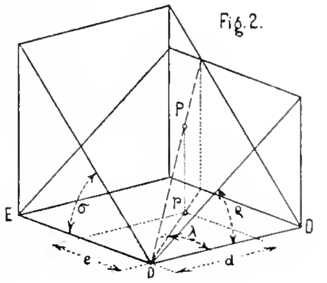
We see that if two different rate schedules are represented by the same surface (or also by the same function f) then the two schedules are identical, in so far as they express the same rate in a different wording, and this resolution of rates into equations or surfaces is a most valuable instrument for determining the true nature of a rate, as will be shown a little later.

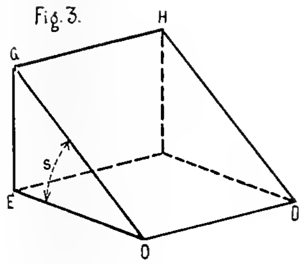
The straight kw.-hr. rate, a = z e, is represented by a plane passing through O D such as O D G H in Fig. 3, where tan s is the kw.-hr. charge z. In this case δ of Fig. 2 is constant and equals s of Fig. 3, since with a straight kw.-hr. rate, the average price per kw.-hr. is constant and equal to the kw.-hr. charge z. The average price per kw. (represented by $\tan \alpha$), however, would be variable.

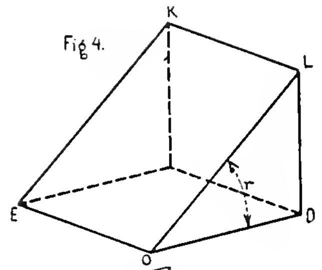
Conversely a flat demand rate would be represented by Fig. 4 and tan r = y = constant = charge per kw. maximum demand. The average price per kw.-hr., $\tan \delta$, is variable.

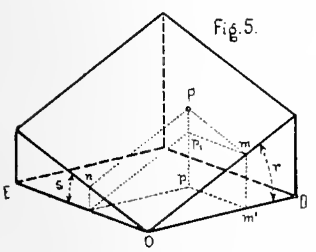
The so-called Hopkinson rate charges a certain amount for each kw. of maximum demand, and besides makes an additional charge for each kw.-hr. consumed. We see that this is a three-charge system with the customer charge x suppressed, and the equation will be a = y d + z e. This rate is a combination of the straight kw.-hr. rate, Fig. 3, and the flat demand rate, Fig. 4, and is therefore represented by a combination of these two figures, that is a plane issuing from the origin O at a certain inclination towards both axes D and E (Fig. 5), where again tan r = y and tan s = z (as can be seen for instance by setting e = O, then the equation of the plane reduces to the equation of the trace on the vertical A D plane a = y d, and since this trace, evidently, according to Fig. 5, has the equation a = d tan r, it follows that tan r = y and in a similar way tan s = z. The algebraical deduction under Fig. 5 arrives at the same conclusion in another way.

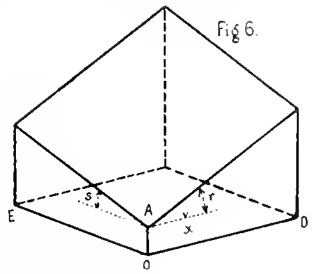


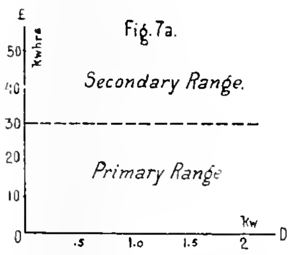


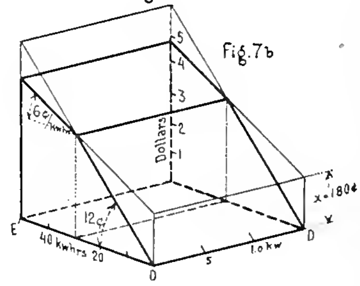












The next step is the general case of the three-charge rate, a = x + y d + z e. All ordinates of the type Fig. 5 are simply increased by a constant amount x, and Fig. 5 changes into Fig. 6 where the customer charge x is geometrically represented by the vertical distance O A above the origin O, at which the plane of rates intersects the axis of a (the same results can be found by setting both d and e = O in the equation of the plane, which will result in a = x for d = e = O).

Not all rates express the three charges in the simple way shown heretofore; in many cases the charges are only implied in the rate, and can be found only by mathematical analysis. The most important of these methods is the block rate system.[1]

A few examples will explain this quicker than abstract deductions:

Let us assume a rate charging 12c per kw.-hr. for the first 30 kw.-hrs., and for the excess 6c per kw.-hr. 12c per kw.-hr. is then called the "primary charge," and the first 30 kw.-hrs. are the "primary range"; 6c

[1] The nomenclature is following the proposals of the Rate Research Committee of the National Electric Light Association, 1912.

per kw.-hr. is the "secondary charge," and all kw.-hrs. beyond 30 kw.-hrs. are the "secondary range," Fig. 7a.

In the primary range ($e<30$) we have a straight kw.-hr. rate:

$a = 12\,e.$

In the secondary range, however, we have to pay 12c for 30 kw.-hrs., and 6c for ($e - 30$) kw.-hrs. We therefore get the following equation:

$$a = 12 \times 30 + 6\,(e - 30)$$
$$= 180 + 6\,e.$$

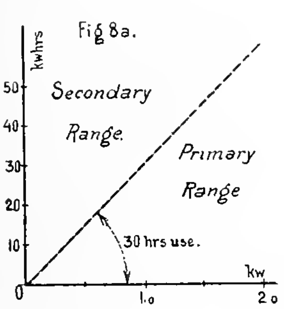
The first term on the right side is independent of both d and e, and is therefore in the nature of a customer charge. The second term is proportional to the energy consumption, and is the result of a kw.-hr. charge. We see that in the secondary range we have a customer charge of 180c—no demand charge—and a kw.-hr. charge of 6c per kw.-hr. The geometrical representation of the rate will look like Fig. 7b.

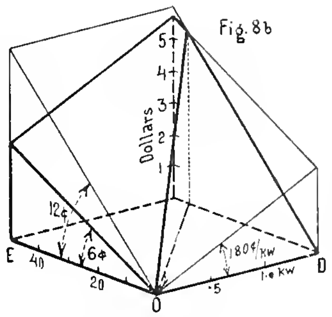
rate) in its secondary range is identical with the Hopkinson rate.

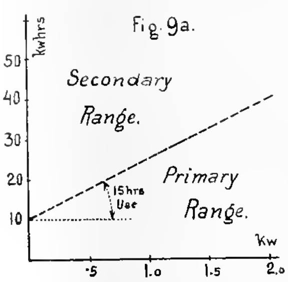
The first named rate (Fig. 7) contains, therefore, the charges x and z, the second named (Fig. 8) y and z, and it may be expected that a combination of the two will express all three charges, x, y and z.

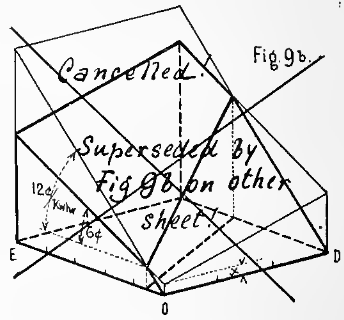
A rate of that kind would be, for instance: 12c for a number of kw.-hrs. which is made up of 15 hours' use of the maximum demand plus 10 kw.-hrs.; 6c for the remainder of the kw.-hrs. Thus, for instance, if a consumer with 2 kw. maximum demand has consumed 60 kw.-hrs., he has to pay at the primary rate: $(15 \times 2) + 10 = 40$ kw.-hrs., and the balance of $60 - 40 = 20$ kw.-hrs. at 6c. The primary and secondary range are represented in Fig. 9 a. The equation for the secondary range is

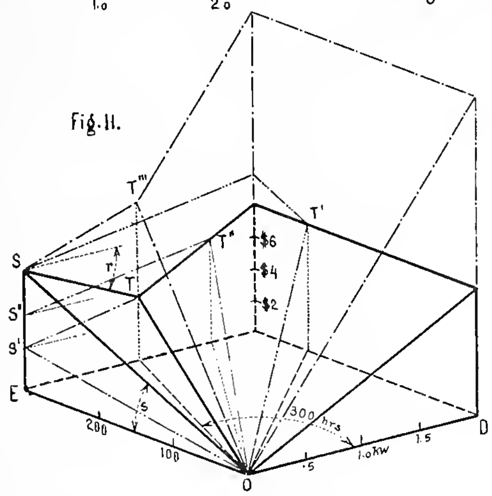
$$a = (15\,d + 10) \cdot 12 + [(e - 15\,d + 10)]\,6$$
$$= 60 + 90\,d + 6\,e.$$

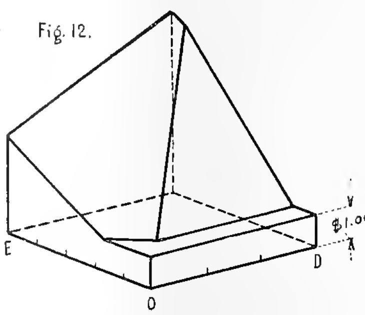


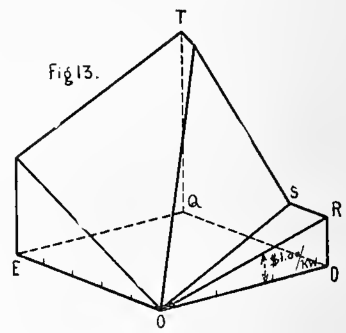












If the rate should now specify, for instance, that a lower secondary charge takes place not after the first 30 kw.-hrs., but after the first 30 hours' use of the maximum demand, or in other words, after the load factor of 30 hours is reached, then we have in the primary range again $a = 12\,e$, but the primary range as per Fig. 8a is different from what it was in the first example. In the secondary range we have to pay that number of kw.-hrs. at 12c, which corresponds to 30 hours' use of the demand d, or in other words 30 d kw.-hrs., and the balance of the kw.-hrs. at 6c; that is

$$a = 30\,d \cdot 12 + (e - 30)\,6$$
$$= 180\,d + 6\,e.$$

That means we have in this case in the secondary range no customer charge, a demand charge of 180c per kw., and a kw.-hr. charge of 6c, which is conform to the model Fig. 8b. The model and the equation show alike that this rate (which is the famous Wright

We have a customer charge $x = 60$c per month
a demand charge $y = 90$c per kw. per month
and a kw.-hr. charge $z = 6$c per kw.-hr.

There is a variety of different other ways to the same end of working the equivalent of a customer and demand charge into the rate; for instance, by giving certain discounts on the price of the kw.-hrs. in the secondary range, or by following the method of the St. Louis residence rate, which has been analyzed by the author in the "Electrical World" of March 23, 1912.

[To be continued.]

The Berne radio-telegraphic agreement as to ship call letters is being rapidly conformed to by Pacific Coast ship-owners. The international bureau has assigned the W group of letters to vessels plying in the Pacific.

WESTERN LAWS OF ELECTRICITY AND WATER

THE RECLAMATION ACT.

BY A. E. CHANDLER.

In the case of United States v. Hanson, 167 Fed. 881, the Federal Circuit Court of Appeals thus expressed itself regarding the need for the Reclamation Act:

Congress passed the Reclamation act to make marketable and habitable large areas of desert land within the public domain, which lands are valueless and uninhabitable unless reclaimed by irrigation and the irrigation whereof is inmpracticable except upon expenditure of large sums of money in the construction of a system of reservoirs and distributing canals. All previous efforts of the government to make these arid lands available for settlement had resulted in failure. By the Desert Land act of March 3, 1875, Congress has made provision for their use by individual settlers, and on March 3, 1877, had enacted further legislation to facilitate the reclamation of such lands by private entrymen, and in 1894, to provide for the irrigation of the arid public lands, had passed the Carey act, by which it proposed to donate to the states in which such lands were located, so much thereof, not exceeding one million acres in each state, as the state would cause to be reclaimed. These efforts having failed to accomplish the desired end, the Reclamation act was passed.

Although the above statement may be considered entirely too strong by many who have watched the development under the Carey Act, it is certain that the many western societies interested in irrigation labored for years to secure the passage of some act under which the nation itself would do the actual construction work in connection with storage and diversion projects. After many unsuccessful attempts the Reclamation Act was finally passed on June 17, 1902.

The Act creates a fund known as the "Reclamation Fund" from the moneys received from the sale of public lands in the following western states: Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Utah, Washington, and Wyoming. As the public lands in Texas belong to the state, the original Act did not include Texas but its provisions were later extended to Texas by special congressional and state legislation.

The Secretary of the Interior is authorized to do the many things provided for in the Act and in connection with the development of any project he must withdraw from public entry the lands required for the irrigation works and also must withdraw from all entry, except under the Homestead laws, the lands deemed irrigable under the proposed project. If later the project is held to be not feasible the lands so withdrawn are to be restored to entry. The two withdrawals mentioned above were originally called first form withdrawal and second form withdrawal. As the irrigable lands could be entered under the Homestead Act, although subject to all the limitations and conditions of the Reclamation Act, they were settled upon in many cases just as soon as it was known that a Reclamation project was proposed. As the project had not been sufficiently developed for the Land Office to know what lands would be irrigated, much land was occupied above the canal lines. Furthermore, as the project was slowly developed and as the settlers had few means of making a livelihood, there was much dissatisfaction. This difficulty was removed in the later projects by the Secretary of the Interior withdrawing all lands under the first form. There was some question as to the legal power of the Secretary to withdraw irrigable lands under the first form and the doubt was removed by a Congressional Act in 1910. By an amendatory Act approved February 18, 1911, it is provided that no entry shall be made and no entryman shall be permitted to go upon lands reserved for irrigation purposes until the Secretary of the Interior has established the unit of acreage, fixed the water right charges and the date when water will be delivered.

As soon as a project is found practicable and contracts have been let, the Act provides that the Secretary "shall give public notice of the lands irrigable under such project, and limit of area per entry, which limit shall represent the acreage which, in the opinion of the Secretary, may be reasonably required for the support of a family upon the lands in question; also the charges which shall be made per acre upon the said entry, and upon the lands in private ownership which may be irrigated by the waters of said irrigation project, and the number of annual instalments, not exceeding ten, in which such charges shall be paid and the time at which such payments shall commence." The charges announced by the Secretary in the public notice are determined with a view of returning to the fund the cost of the project and in practice are apportioned equally throughout the project.

The public lands subject to entry can be entered only under the provisions of the Homestead Act in tracts not less than ten nor more than one hundred and sixty acres. The entry is subject to the limitations and conditions of the Reclamation Act and the commutation provisions of the Homestead Act do not apply. The original Act placed the minimum area at forty acres. Before receiving patent the entryman must reclaim at least one-half of the total irrigable area of his entry and must pay the charges apportioned against the land entered.

Although private lands may be included within the project, no water right for such lands can be sold for a tract exceeding 160 acres to any one landowner, "and no such sale shall be made to any landowner unless he be an actual bona fide resident on such land or occupant thereof residing in the neighborhood of said land, and no such right shall permanently attach until all payments therefor are made." The Secretary has ruled that residence within fifty miles of the land shall be construed as "residing in the neighborhood of said land." It has also been held that a corporation is entitled to hold land under a government project, but as a condition precedent thereto a showing must be made that the aggregate area held by the corporation and its stockholders in their individual capacities does not exceed one hundred and sixty acres. As each individual is allowed to hold one hundred and

sixty acres of private land under such a project, there is little incentive for corporate holdings.

The Secretary is authorized to use the Reclamation Fund for the operation and maintenance of reservoirs and irrigation works. When the payments required by the Act are made for the major portion of the lands irrigated, the management and operation of the irrigation works is to pass to the landowners thereunder to be maintained at their expense under some form of organization acceptable to the Secretary; but "the title to and the management and operation of the reservoirs and the work necessary for their protection and operation shall remain in the Government until otherwise provided by Congress." It is noteworthy that the Act does not specify that the title to the irrigation works shall pass to the landowners. The only inference, therefore, is that the title to the works, as well as reservoirs, is to remain in the Government.

As in a number of other Congressional acts, it is expressly stated in this Act that it shall not be construed as interfering with state or territorial laws regarding the appropriation, use or distribution of water used in irrigation, or as in any way affecting any right to the waters of an interstate stream. The Secretary is directed to proceed in conformity with the local laws. The doctrine of appurtenancy is included in the following language:

Provided, That the right to the use of water acquired under the provisions of this act shall be appurtenant to the land irrigated, and beneficial use shall be the basis, the measure, and the limit of the right.

The original Act provided that within each ten-year period the major portion of the funds arising from the sale of public lands within any state or territory should be expended within the limits thereof. The section so providing was repealed by Congress in 1910 so that the Secertary is now at liberty to expend moneys on feasible projects regardless of the geographical source of such.

As stated above, the operations under the Reclamation Act are under the Secretary of the Interior. Prior to the passage of the Act in 1902, the Hydrographic Division of the Geological Survey had been making surveys of reservoir sites and proposed canals in many of the western states. After the passage this Division became the Reclamation Service under the supervision of the Director of the Geological Survey. In 1906 the Service was made a separate bureau of equal standing with the Geological Survey and its own director.

One of the first projects undertaken was the Salt River project made up of lands about Phoenix in Arizona. As practically all the lands included were in private ownership the question immediately arose as to what lien should be given the Government to induce it to build the project. The lien in the case of public land is assured as the title cannot pass until all the water right payments have been made. To satisfy the requirement in regard to the private lands, the first so-called Water Users' Association was formed. The shareholders of this association, which is regularly incorporated, are the landowners under the project. The capital stock is fixed at the estimated cost of the project and each acre is entitled to one share of stock. The association enters into a contract with the Secretary of the Interior pledging itself to repay the cost of construction. Each shareholder in executing his stock subscription agrees that the payments due upon his stock shall be a lien upon his land and shares, and that the lien may be enforced by the association by foreclosure in the manner provided by law for the foreclosure of mortgages. The land is thus bound to the association and the association to the Secretary.

Although not necessary as far as the lien is concerned, the practice has been to compel entrymen on the public lands to become stockholders in the association. As provided in the Act, the payments must be paid in ten annual instalments and the practice is growing of fixing a graduated scale for the instalments, so that they may not be heavy during the first few years. The association levies assessments on the shares of stock from year to year to pay the instalments. As the Act provides that the water right payments must be made to the local Land Office, a certificate from such office is accepted as payment by the association.

The receipts from the sale of public lands to June 30, 1910, and excepting the five per cent of such proceeds set aside for educational and other purposes, were $65,584,801, and the estimated total receipts to June 30, 1911, including $213,998 from the sale of townsite lots, were $71,717,990. The net investment of this fund in reclamation works on June 30, 1911, amounted to $60,940,834.

No new projects have been undertaken since March 4, 1909, and up to that time thirty-two primary projects (that is, projects actually under construction) have been undertaken, the net investment in which on June 30, 1911, amounted to $59,989,158. The area of land to which water could be supplied under such projects on June 30, 1911, was 1,025,609 acres and the total area under such projects was 3,101,450 acres. The charges levied on lands under such projects are divided into "water right building charges" and "water right operation and maintenance charges." The aggregate return for the former to June 30, 1911, was $1,533,176, and for the latter, $517,394.

A number of the projects are so large that it was originally planned to complete only a portion and allow the returns from the Act itself to pay for the extension work. In order to complete such projects in the immediate future, Congress in 1910 authorized a special bond issue of $20,000,000, no part of which can be spent on new projects.

As was to be expected where the operations are of such magnitude and cover so much territory, the constitutionality of the Reclamation Act was early attacked but thus far it has been upheld (United States v. Hanson, 167 Fed. 881; Burley v. United States, 179 Fed. 1). In a former paper the Kansas v' Colorado case was discussed and it was stated that many at first supposed that the Reclamation Act was therein declared unconstitutional. The point made by the Court, however, was that Congress could not override state legislation in regard to the reclamation of arid lands and the Supreme Court went on to show that the Reclamation Act not only did not do so, but specifically provided for the observance of local law. In the paragraph of the decision showing the power of the Gov-

ernment to reclaim lands emphasis is laid upon the reclamation of lands within the territories and upon the reclamation of public lands within the states. In the two cases cited above as upholding the constitutionality of the Reclamation Act, the question of the power of the Reclamation Service to build projects for the irrigation of private lands only, within a state, was not raised. In the second of the two cases (Burley v. United States, 179 Fed. 1) the Court said:

It would be strange if the national government could enter the territory of a state where there were no public lands of the United States requiring irrigation and no public lands through which water flows necessary for the irrigation of arid lands, and by legislation provide a system of irrigation for the private lands within the state and control its administration. It would, indeed, be a strange proceeding, and obviously wholly outside of the authority of Congress.

But in this case the United States is the owner of large tracts of land within the states named in the act of June 17, 1902. The public welfare requires that these lands, as well as those held in private ownership, should be reclaimed and made productive. To do this effectively and economically with the available water supply large tracts must be brought into relation with a single system or project. These states having arid lands have accordingly acted upon the subject.

The Reclamation Act has now been in operation ten years and practically all of its thirty-two primary projects are furnishing water to settlers or landowners by canals constructed by the Government or purchased as a part of the project. As the water right charges in a number of cases are in excess of $40 per acre, the burden of meeting the first payments is in many cases a heavy one. There have, therefore, been constant appeals for relief. In commenting upon a suggested relief measure before the Senate Committee on Irrigation, Secretary of the Interior Fisher recently wrote as follows:

The passage of this resolution would lead to similar demands from a similar group of settlers on every project. The descent through successive general postponements to complete repudiation of a just debt may now be clearly discerned and easily made.

The Reclamation act was passed in 1902 primarily for the benefit of the West and upon the request of Western Senators and Representatives. Many voices were raised against it in the East freely predicting that the beneficiaries of this large expenditure would never repay the cost of the works. These prophets of evil did not believe that the government and people of the United States possessed the patriotism and wisdom necessary to carry through such a great and beneficent enterprise by the expenditure of public funds on a basis of justice and efficiency. They held that in a popular government such an enterprise must be dominated by selfishness, and must degenerate into a scramble for special favors at the public expense. Nevertheless, the act was passed in the faith that the pledge of repayment embodied in its terms would be fulfilled. It is my deliberate conviction that the passage of this resolution would be a first and very influential step toward the breaking of that pledge and toward the failure of the beneficent reclamation policy. I desire to see that policy extended and supported by additional appropriations from the miscellaneous public revenue. But the one indispensable condition to its extension, or even to its continuance, is the repayment by the settlers of the cost of the irrigation works. Failing such a repayment not another dollar should be expended in the construction of new projects or in the extension of those already opened.

In framing the Reclamation Act the intention was to make the terms of payment no harsher than then existed under private projects and as no private projects allowed in excess of ten years, that term was adopted. A great many viewing only the governmental character of the enterprise believe that this period should be extended to twenty or more years. The only reason suggested for greater leniency under government projects than under private projects is that the Reclamation Act necessitates residence upon or in the neighborhood of the land. It thus precludes the purchase of land by one who wishes to hold his present position and pay for the immediate improvement of the land by someone on the ground, with the intention of making the tract his home after reaching the productive stage. This course is possible under private projects and not only means that the absent owner and probably inexperienced farmer may in time possess a tract easily farmed, but also is a source of income to those residing on the project. The only object of the residence restriction in the Reclamation Act is to avoid speculation and by many it is believed that the restriction works against, rather than for, the project. It is certain that the period for speculation is the time prior to the delivery of water; that is, when the land values are comparatively low and when no payments need be made. As soon as the water is ready for delivery and the charges are imposed, traffic in land almost immediately ceases and the element of speculation disappears. It is probable that Congress will realize this condition in time and repeal the obnoxious residence clause.

The Reclamation Act, in brief, provides a revolving fund—first accruing from the sale of public lands in the western irrigation states—for the construction of irrigation works by the government for the irrigation of both public and private land and for the repayment of all moneys so expended by the settlers and landowners under the project. It aims to secure actual irrigation by providing that the title to the water right shall not be given until half of the land has been actually cultivated. The management of the canal system is turned over to the water users thereunder when a majority of the payments have been made.

BUREAU OF STANDARDS REPORT ON STATE GAS LAWS.

The National Bureau of Standards has prepared a report summarizing the provisions of the state gas laws, which shows that only sixteen out of the forty-eight states have laws for the regulation of gas service. Candle-power requirements are provided in the laws of California, Maryland, Massachusetts and New York. Sixteen candle-power is required in all California cities of more than 100,000 population. Twenty candle-power is required in Maryland for water gas, and about 17 c.p. or 18 c.p. for coal gas. In Massachusetts the minimum is 16 c.p. The requirement in New York is 16 c.p. for coal gas, 18 c.p. for mixed gas and 20 c.p. for water gas. An exception exists for the city of New York, where the requirement is 22 c.p. Wisconsin, New Jersey and Nevada are the only states in which a heating-value requirement exists under the statute. In Wisconsin and New Jersey the monthly average of gross heating value is required to be not less than 600 thermal units per cubic foot of gas, with a minimum of 550 thermal units. The corresponding requirements in Nevada are 550 and 500 thermal units respectively.

PHOTOGRAPHY IN ENGINEERING

BY M. R. LOTT.

Fixing.

After development the plate should be rinsed in water before being placed in the fixing bath. The combined fixing and hardening bath serves to clear the plate by reducing the silver bromide not already affected by the light and developer, and to harden the film. The length of time required for this operation depends upon the strength and temperature of the bath and should last four or five minutes after the whiteness of the film has disappeared. The formula for a chrome alum fixing and hardening bath is given later, hypo being the agent which acts upon the silver bromide.

Washing.

After fixing, the negative must be thoroughly washed to remove all traces of the hypo and to dissolve out the silver thiosulphates in the film, otherwise when the plate is dried it will have a stained and crystalline appearance which spoils its printing qualities. Washing may be accomplished either by means of flowing or still water. It is really a matter of time rather than quantity of water required. Washing may be most rapidly accomplished when running water is used. The plate is placed film upwards in a tray and the water allowed to flow over it. Forty-five minutes will be required for a thorough washing. A washing box is a great convenience, for it allows a number of plates to be washed at the same time. The water is arranged to flow upward past the plates from a pipe located in the bottom of the box.

When running water is not available, washing may be accomplished by soaking the negative in a tray of clean water for an hour. The water should be changed six or eight times during that period.

Drying.

After the washing process has been completed the plate should be gently swabbed with a tuft of cotton to remove any particles of sand which might be present, and then placed in a drying rack. Heat should never be applied, though a current of air from an electric fan may be used to hasten the drying process. The warmer the air in which the negative is dried, the more intense it will be.

Alcohol may be used to hasten drying, though its use is not recommended, for the film is apt to pucker, due to uneven drying. The use of a fan is much more satisfactory and its action is quite rapid. The action of the alcohol is to penetrate the film and force out the water when the negative is placed in a tray containing it. After the alcohol has had an opportunity to penetrate the film the negative is taken out in the air, where it will dry rapidly.

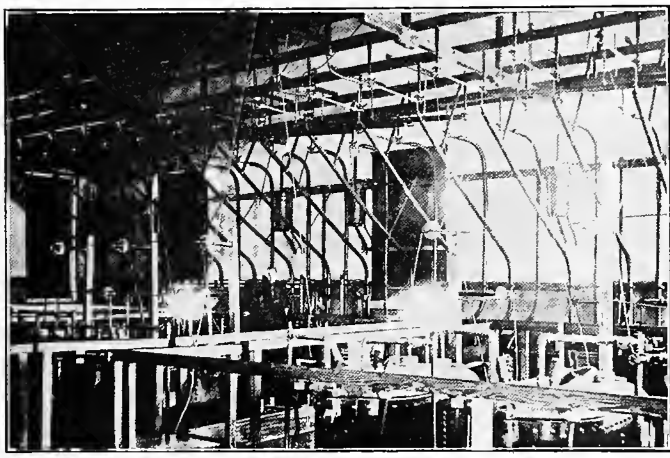
Retouching.

When the negative is thoroughly dried it should be taken to the retouching stand, where spots caused by dust, as well as undesirable portions of the negative, may be eliminated by the use of opaque. Opaque is a thick red paint prepared as used by mixing it with water. It should be applied with a camel's-hair brush. A dense negative will stand retouching much better than a thin one, for the operation will not be so readily detected when the print is made.

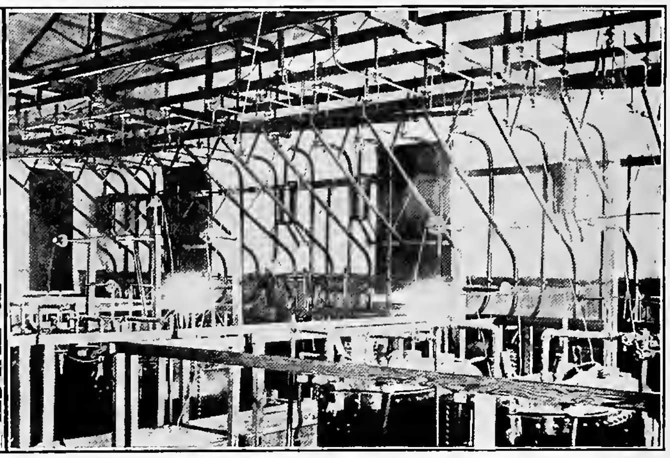
A neat way for handling the negatives made by photographing a drawing is to block it out to within a sixteenth of an inch of the border line on the film, the black paper used for lining plate and paper boxes being very good for this purpose. The paper should be pasted on the film side of the plate and then folded over and pasted on the glass side. This method has an additional advantage, for it allows plates to be stored away without scratching the film, as well as helps to protect the plates from breakage.

Printing.

Velox developing paper is an excellent kind of printing paper to use. The grade of paper suitable for the negative should be selected in each case. To secure contrast, regular carbon velox is very good and is particularly adapted for use with negatives made by photographing drawings. Velvet velox is good for landscapes and out-of-door views. The regular grade of velvet velox is used for most purposes and special is used with negatives having a great deal of contrast.



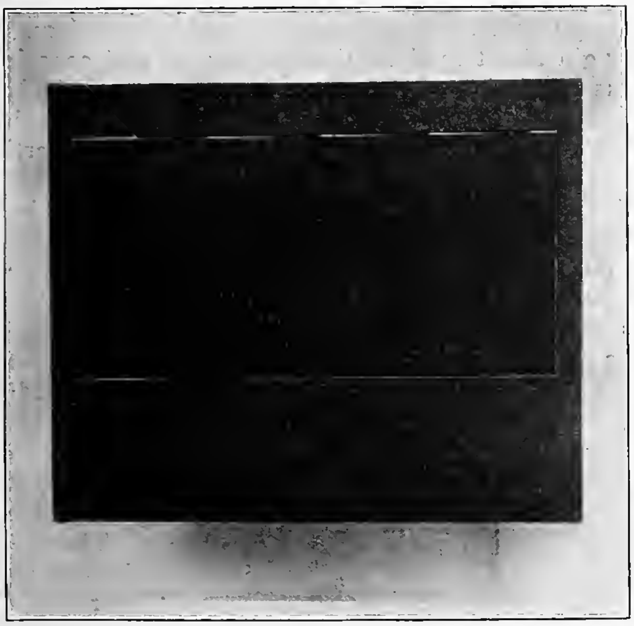
Print Made from Negative With No Attempt to Shade Under-exposed Part.



Prine Made from Same Negative Using Cardboard Shading.

Printing may be accomplished either by means of a printing frame and a tungsten light or a printing box. When the negative is to be printed it is placed in the frame with the film side up, the paper concave side down, being next to the film, the cover is clamped down and the exposure to the light is then made. The time required for exposure depends upon the negative, dense ones printing slower than thin ones. Experience in judging a negative is the only guide for estimating the correct exposure.

The printing qualities of a negative may sometimes be greatly improved by shading; that is, by shielding the desired portion of the negative from the light. This applies to the sky portions of some negatives and to those which have a different intensity



A Negative Blocked Out With Black Paper to 1/16 in. of Border Line.

on different portions of the plate. Shading may be accomplished by means of a cardboard kept in motion between the negative and the light, the amount of shading required depending upon the negative. The cardboard must be kept in motion to prevent a definite shadow being formed on the print.

As velox is a developing paper—that is, a paper with a film in a manner similar to a dry plate—no image will appear until the development takes place. After exposure has been made the print should be immersed in water to insure an even flow of developer over it when it is placed in the solution. A print should be exposed long enough to require at least 15 seconds in the developer in order to secure the full brilliancy which exists when the blacks and the whites are both clear. Care must be taken not to use developer which is old or too weak, for stained prints will surely result from the length of time required to develop.

When the print is taken from the developing solution it is well to rinse it in water before placing it in the fixing bath. The fixing solution is made up of hypo and an acid hardener, the proportion of hypo not being as great as in the fixing bath used for plates, as it is apt to blister the prints. The time required for fixing the prints depends upon the strength of the bath. When potassium iodide is put in the developer it furnishes a means for indicating when the operation is complete, the iodide giving a yellow color to the prints which disappears when fixing is complete.

Prints which have been printed too deep may be reduced by use of the reducing solution given later. Places which need to be reduced locally should be treated with potassium cyanide either in the form of a solution or in the solid form being applied directly to the print. Potassium cyanide will also remove stains.

The prints must be given a thorough washing when they are removed from the hypo bath. The sink arrangement previously mentioned offers a convenient method. An hour's washing in running water is sufficient to remove all traces of hypo, provided the prints do not pack closely.

To dry prints, they may be placed face down on clean cheese cloth. A rack containing removable frames to which cheese cloth, tightly stretched, is tacked. The frames are stacked one above another, providing a means for accommodating a number of prints at the same time.

Prints have a tendency to curl up as they dry, but may be straightened by drawing the prints under the edge of a triangle or ruler. After this treatment they may be further flattened by placing them in a letter press.

Prints should be trimmed to the desired size by means of a print trimmer. Photographs of tracings and drawings made on 10 in. by 12 in. plates may conveniently be trimmed down to letter size, 8½ in. by 11 in., making them suitable for binding with reports, etc. The trimming process tends to keep the prints flat, because it removes the edge which tends to curl.

When prints are mounted, they should be first immersed in water and laid face down on glass (glass-topped work table in the studio), one above another, so that two edges of each print are uncovered for about an eighth of an inch for convenience in picking them up. The surplus water is then removed by a roller. Paste is applied to one at a time as they are used. A roller helps to make the prints stick and to remove the air from underneath when the prints are placed on the mounts.

Every negative should be numbered and placed in a file and a catalogue made of the prints from each one for convenience in identifying them.

U. S. GOVERNMENT HEARING ON FLANGE FITTINGS.

The Navy Department, Bureau of Yards and Docks, Washington, D. C., held a hearing June Seventeenth for the purpose of giving certain manufacturers an opportunity to give reasons why they do not recommend the use of the 1912 U. S. Specifications on Government work. The consensus of opinion at the hearing was in favor of the 1912 U. S. Standard. During the remainder of the hearing the discussion settled down to what time would be necessary before everyone could be supplying material according to the 1912 U. S. Standard and the general consensus of opinion seemed to be that within two years the new standard would probably become universal.

NO HONEST CORPORATION FEARS HONEST REGULATION.

BY R. H. BALLARD.

Public service and the control of public service corporations is a vital question of the hour with the people at large in this, and practically all sections of the country. It is naturally a most important question to those of us who are engaged in supplying public service. It has been difficult for some of us who are connected with public service corporations to fully appreciate that our business is different from the private business of our friends and neighbors.

A comparatively few years ago, public service corporations, about which so much is said today, were unknown. The business now being done by these

R. H. Ballard.

corporations was generally limited to a very confined radius and conducted by individuals who found their own capital was ample to carry on the business as it then existed. In the last few years, however, the development of the country has been so great that the demands for capital for extensions were more than could be met by individuals. This resulted in the combining of individual efforts and in the formation of the corporations of the present day.

There are those who have a feeling that a corporation is some hidden monster antagonistic to the people at large, and against the government. It is not unusual to meet a man who will say "I know your president; he is a fine man; you have a fine lot of fellows in your company, but I have no use for corporations."

Such a man certainly does not realize that a corporation is simply a collection of men who have come together to work in a co-operative way to accomplish some great enterprise that no one man can carry out alone. We say that the president and other officers and heads of departments work for the corporation. This is a mistake. They are not working for the corporation, but in reality are the corporation. If the public has confidence in these men, then it should have confidence in the corporation. These men have a duty to perform in the protection of the property entrusted to their care, which has been purchased with moneys invested by the general public in the enterprise. Receipts for this money are issued in the form of stocks and bonds. Efficient, careful operation is essential to enable the furnishing of the commodity to the public at the lowest possible rates.

It is a common belief that the methods of public service corporations are secretive and that it is their desire to withhold from the public all information pertaining to operation, submitting only such data as may be required by law. It is unfortunate that such belief exists, as I am confident that the modern public service corporation anxiously awaits the time when it may lay all of its affairs before the public with the assurance that such conclusions as are reached regarding its business will be based on all the facts rather than on a possible distortion of one or two items, for political purposes. This condition will doubtless be brought about in time, through careful and conscientious regulation of the affairs of corporations, including not only the regulation of rates of charge, but service conditions, extensions to plants and properties and the issuance of stocks and bonds.

In California a long step in this direction has been taken in the passage of legislation placing the affairs of public service corporations under the jurisdiction of the Railroad Commission. Unfortunately, however, the authority given this commission does not extend to a full regulation of the business of these corporations, and we may, temporarily at least, be forced to meet a condition where the railroad commission will be regulating the issuance of stocks and bonds, and ordering expenditures by the corporation for extensions and improvement, while municipal bodies are fixing the rates to be charged for service. There is a chance that this dual regulation may be inconsistent.

Many benefits will accrue to public service corporations through proper regulation, not the least of which will be the absolute stability of their securities and protection from unnecessary competition.

Investments in tin power houses and cheap inefficient machinery, for the purpose of competing with an established service by charging rates below cost, would not be permitted under a proper system of regulation. Promoters of these schemes seldom give consideration to maintenance or depreciation as they do not expect to be on hand when expenditures from the depreciation fund become necessary.

Perhaps the most popular feature of corporation regulation is the fixing of rates for service, and unquestionably the valuation of the properties of the corporation is the most important element in rate fixing. There are many theories as to the proper basis to be used for valuation, but no basis will stand the test of time and bring about harmonious conditions between the governing bodies and public service corporations that does not take into consideration all of the facts in relation to the establishment of the property. In most cases, much actual expenditure of time and money has been made to bring the property up to its present state of efficiency for which no adequate compensation has been received. It is distinctly unfair to consider as a basis of valuation simply the present value of physical property based on present day prices with deductions therefrom for age. In the elec-

trical lighting and power field, the brunt of the development of the art has been borne by the present companies, and enormous sums of money have been expended in experiments and development. Were it not for these, the art would be much less advanced compared with achievements of today, and it would therefore appear that valuations at simple present day prices with no consideration for the cost of development would be in the nature of taking something for nothing. The companies would receive absolutely no return for the years of work and the money expended in development. If it could be shown by a careful analysis that the earnings of a company in the past had been sufficient to compensate for the cost of these developments, no hardship would be done, but in the majority of cases the earnings in past years have not been sufficient to absorb this, in addition to a fair interest rate on the money invested, and the creation of a proper depreciation fund.

No honestly conducted service corporation need fear honest regulation but politics has no place in fair regulation.

DEFINITIONS OF SOME IMPORTANT TERMS.

Integrated Peak—A peak load as given by an integrating meter for a period of time corresponding to the duration of the peak.

Connected Load-Factor—The Connected Load-Factor is the ratio (stated in per cent) of the kw-hr. registered by a watt-hour meter during any given period (as a day, a month or a year) by any connected load, to the kw-hr. which would have been registered due to same connected load during the same period (day, month or year) if all the apparatus making up this connected load had continuously consumed its full normal kilowatts (rate of current at normal voltage) during the entire period.

Note—Where the kw-hr. readings are not available, the k.v.a.-hours should be substituted. In certain cases, notably alternating-current generators and transformers, the k.v.a. is more important than the kw., if their capacity is being considered.

Capacity Load-Factor—The Plant Capacity Load-Factor is the ratio (stated in per cent) of the kw.-hr. actually delivered by a plant (or by any specific section of a plant such as series direct-current) during any given period (as a day, a month, or a year) to the kw.-hr., which the same plant (or the same section of it) would have sent out had it operated throughout the period continuously at its full normal rating.

Note—Where the kw.-hr. readings are not available, the k.v.a.-hours should be substituted.

Demand Load-Factor—The Maximum Demand Load-Factor is the ratio (stated in per cent) of the kw.-hr. actually delivered by a plant (such as multiple direct current) during any given period (as a day, a month, or a year) to the kw.-hr. which the same plant (or the same section of it) would have sent out had it operated throughout the same period continuously at the maximum rate recorded.

Note—Where the kw.-hr readings are not available, the k.v.a.-hours should be substituted.

Daily Load-Factor—The load-factor obtained by taking the mean load for one day, and dividing it by the peak load during that day.

Yearly Load-Factor—The load-factor obtained by taking the mean load for the year, and dividing by the peak load recorded during that year.

Integrated Value—The summation value of varying quantity over a definite period of time.

Note—The readings of watt-hour meters are integrated values, and are read by taking the difference between readings at the dial at the beginning and end of a definite interval of time.

Maximum Demand—The highest demand measured in a manner agreed upon or stated.

Note—The maximum demand may be based on the reading of a watt-hour meter for one hour, one-half hour, or any other period of time, or upon the readings of an indicating instrument, in which case, it should be called maximum indicated demand.

Maximum Indicated Demand—The highest load reached in a stated interval as given by an indicating or curve-drawing instrument.

Maximum Simultaneous Demand—The highest load at any time required to supply a number of individual equipments.

Note—The maximum simultaneous demand must be less than the sum of the individual maximum demands, if the latter do not occur at the same moment.

Peak Load—The highest load carried during a specified interval of time.

Note—Both the method of measuring the peak load and the interval of time covered should be specified. Thus, daily indicated peak load, or yearly peak load, for one hour, are correct expressions.

Simultaneous Demand—The sum of the demands, or load existing at the same time on a number of services.

Note—The simultaneous demand cannot be greater and will generally be less than the sum of the individual demands.

Watt-Hour Meter—An instrument registering watt-hours passing through an electric circuit. This term should be used in place of "Integrating" wattmeter, or "Recording" wattmeter.

GAS AND OIL ENGINES.

To meet the demand for information concerning internal-combustion engines and gas producers, the United States Bureau of Mines, Washington, D. C., has issued technical paper No. 9, entitled "The Status of the Gas Producer and of the Internal-Combustion Engine in the Utilization of Fuels," by Robert H. Fernald. Many valuable data are contained in this pamphlet, copies of which may be obtained upon application.

A GREATER LOS ANGELES.

One method whereby Los Angeles may evade the dictum of Chairman John Eschelman of the State Railroad Commission that outlying communities are not to be charged an excess rate for Aqueduct water is contained in a proposal of the civic bodies that all that part of Los Angeles County from the Orange County boundary and the Pacific Ocean to a point in the foothills, two miles east of Glendora, then following the contour of the foothills to the ocean and along the shore line to the starting point be included in the city limits.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

NOTES.

Many a municipal electric railway franchise is today in about the same position as the mule team which the electric car displaced,—no pride of ancestry, no hope of posterity.

The important position which the electrical contractor occupies in relation to the other elements of the industry bears a dual resemblance to the conundrum as to why the focus of a burning glass is like the father's stock ranch in Texas,—where the sun's rays meet (sons raise meat).

Novel uses for the electric current are being devised with such startling rapidity as to baffle completeness of record. The latest idea from Grandview, Washington, is to supersede hot air drying of fruit by electric drying. An electric fruit picker seems to be the only missing link in the chain of electric irrigation, electric drying and electric traction from the tree to the consumer.

A Dissertation on Regulation

The pendulum symbolizes regulation of physical matters. So regular are its movements that it is used to arbitrarily measure time, the most infinite of concepts, by the aid of gravity, the most constant of forces. Yet it is only after going to either extreme that it establishes the position of eventful equilibrium.

The public service commission typifies regulation of human affairs, meting out justice, which can be grounded only in the absolute and eternal, by the aid of public opinion, the most powerful of forces. Like the pendulum, it performs its functions by going to extremes.

Synchronism is not essential to regulation. The decisions of one commission may lag behind those of a second and lead those of a third, and yet the final outcome may be the same.

Today the California commission is being criticised because its opinion on competition as a means of regulation does not exactly coincide with the opinions already rendered by the commissions in Massachusetts, Wisconsin and New York. In its first three important decisions it allows electric power companies to enter a field already served by others, basing its ruling largely upon the contention that the adequacy of past service was not established. The balance of evidence favored the winners.

But in future cases it will be necessary to regulate rates for service. According to the cost data presented in the course of the first contentions a reasonable return on the investment of the one company means a wholly inadequate return on the investment of the other. The pendulum swings back. The futility of regulation by competition becomes evident when the competitors consolidate. The higher law, slow as time, resistless as gravity, brings the extremes nearer and nearer to the position of eventual equilibrium, a regulated monopoly.

Troubles of The Electrical Contractor

The electrical contractor complains that he works the hardest and earns the least; that he finds it more difficult to borrow money than to hoodwink the inspector, a well nigh impossibility; and that in the end he is allowed a choice between the insane asylum and the almshouse, only because the debtors' prison is a relic of the past. The entire electrical industry is otherwise in such a high state of efficiency and prosperity as to demand a serious investigation of the justice and correctness of these complaints and a careful study of how they may be remedied.

The fundamental reasons for the contractor's plight are not obscure. They are not primarily due, as is often claimed, to the architect or to the jobber, but to the contractor himself. Contracting is no longer a mere trade but a business. Business methods must be combined with manual skill to avoid failure. And the first commandment in the decalogue of business success is "Know thy costs."

The time has come for the electrical contractor to stop fault-finding and begin cost-finding. He is in business for profit and profit is gained only when cost is known. Cost is based on precise facts. It cannot be determined by approximation. Round numbers do not roll into round dollars, nor does profit associate with perhaps. When a contractor stakes his chance of loss or profit upon a guess he is gambling. Ignorance of cost allows price to be dictated by the customer and the contractor not only jeopardizes his own interests, but demoralizes the trade at large, particularly his competitor who tries to meet his unfair prices.

But cost-finding no more consists in the installation of a set of furniture and forms than does poker playing in the ownership of a deck of cards and a stack of chips. A contractor may have a ton of forms adapted for use in his business and not have a single advantage of a cost system. Cost finding is one of the most exact of sciences and its rules must be known by those who sit into the game.

The first rule, and the one hardest for the average contractor to learn, is that the operation of a cost system, as a definite, practical, clerical routine pursued for the purpose of determining costs, should be the primary duty of one who is not already burdened with as many details as is the manager of the business. A system is valueless unless the records are properly and consistently kept and the extra cost for clerical work is paid many times over by the saving effected in not being awarded contracts at cost or less. Increased volume of business does not always mean increased profits, while elimination of profitless jobs give more profit by doing less business. After he learns the true cost, the manager should see to it that every contract shall show a fair margin above it and also that the cost is not exceeded by careless workmen.

The greatest responsibility for failure to correctly estimate a job, and consequently for failure in the contracting business, rests with the workman. With the present unsettled labor conditions, such as are exemplified in the city of San Francisco, a contractor can never be certain but what his original estimate will be exceeded because of unforeseen and unreasonable demands from his workman. No matter how carefully he subdivides the work, how minutely he figures the various items, or how carefully his estimates are checked, his ultimate profit will always be in question until stable labor conditions can be assured. It is a fallacy to assume that wages bear any relation to the value of an hour's product and can be used as the basis of price making in the absence of a cost system The time will come when the labor organizations will be subject to the same responsibility and liability as any other business organization, but until this relief is afforded electrical contracting must remain a hazardous venture under the exceptional conditions noted.

Such are the relations affecting cost conditions, the first commandment. In succeeding editorials these questions will be more thoroughly discussed and also the second commandment taken under consideration. "Know thy competitor." It is hoped that these can be discussed in a broad and fair-minded attitude of mind and with this end in view contractors and others are invited to make free use of these columns in order to shed light on every phase of the contractors' trouble.

An Engineer's Club

As noted on another page, the engineers of San Francisco are establishing a social club. From its modest beginning as a weekly lunch assemblage it is planned to expand into the dignity of a first-class club. There has long been need for such action and the personnel of the present promotors is such as to merit success.

Each of the national engineering societies have local sections which hold frequent technical meetings, but the social features have been somewhat neglected. The objects of this new organization are most commendable and its effect should be beneficial in removing the groove of isolation into which the specialist tends to burrow. As has been aptly remarked, such a groove differs from a grave only in its length and depth. The broadening influence of a club is essential in co-ordinating an engineer's work and in preventing mental warping. He can appreciate his own function in the plan of the universe only by coming in contact with others.

Just as collective has succeeded individual specialization, so is co-operation succeeding competition. The latter is as intense between engineers as in any other profession. It occasionally engenders hard feelings which can be smoothed out only by social meeting.

Furthermore, there is a decided need for a general engineering headquarters in a building occupied exclusively by engineers. The upper floors could be occupied as club rooms, a large auditorium provided for institute meetings and offices rented to engineers. It is hoped that this new club will succeed in fulfilling these requirements at an early date.

PERSONALS.

Robert Sibley, editor of this journal, is spending a two-weeks' vacation at Carmel-by-the-Sea.

C. O. Poole, of the electrical engineering firm of Manifold & Poole, of Los Angeles, is a recent arrival at San Francisco.

Frank Lackner, of the engineering staff of the H. K. Porter Locomotive Works, of Pittsburg, is a San Francisco visitor.

R. D. Holabird, president of the Holabird-Reynolds Company, has just returned to San Francisco from an outing at Lake Tahoe.

L. D. Armstrong, of the Vix Engineering Company, has returned to San Francisco after a trip through the interior of California.

Clyde Smith, of the engineering department of the American Bell Telephone Company, is among the recent arrivals at San Francisco.

Charles Froding, of the Power Specialty Company, 814 Balboa Building, has returned to San Francisco from a month's eastern trip.

A. H. Babcock, hitherto electrical engineer of the Southern Pacific's Alameda County electrification, is given the title of consulting electrical engineer.

F. H. Woodward, formerly sales manager, has been placed in charge of the industrial and public service business of the Great Western Power Company.

C. F. Henderson, who was formerly connected with the Bermingham works, has joined the San Francisco sales force of the Crocker-Wheeler Company.

D. P. Robinson, president of the Stone & Webster Engineering Corporation, and **G. O. Muhlfeld**, the general manager, are at Seattle, after visiting California.

R. A. Bowden has left the apparatus sales department of the General Electric Company's San Francisco office to take a position with the Great Western Power Company.

R. G. Littler of the West Coast Engineering Company of Portland is attending the National Electrical Contractors' Convention as the delegate from the Oregon association.

H. R. Noack, president of Pierson, Roeding & Company, returned to San Francisco during the past week after a very successful hunting and fishing trip through the mountains.

F. F. Skeel, Western sales manager of the Crouse-Hinds Company, has finished a months' visit at Los Angeles and is now at Seattle. He will return East by way of San Francisco.

H. H. Sanborn, the rate expert of the Railroad Commission, and Commissioner **J. M. Eshelman**, are at Klamath Lake, and Commissioner **Max Thelen** is in the Sierras on a vacation.

W. S. Hanbridge, Louis Levy and **John Rendler** are attending the annual convention of the National Electrical Contractors' Association at Denver, Colorado, as representatives of the California Association.

R. F. Behan has returned to the Westinghouse Electric and Manufacturing Company's San Francisco office, after having observed the work in progress on the new development of the Pacific Gas and Electric Company.

F. H. Poss, manager of the Pacific Coast departments of the Holophane Company and of the Benjamin Electric Company, has returned from a vacation at Aetna Springs with Mrs. Poss. They motored through Lake County.

L. H. Baldwin, the northwestern representative of the Kellogg Switchboard and Supply Company, has returned to his headquarters at Portland after making an extensive Alaskan tour and finding business excellent with his lines.

H. E. Sanderson, Pacific Coast district manager of the Bryant Electric Company, has just returned to San Francisco from Los Angeles, accompaning **E. K. Patton**, the western sales manager, both continuing on a trip to Seattle.

R. J. Johns, export representative of the H. W. Johns-Manville Company, passed through San Francisco last Sunday on his way from Australia and China to New York. He reported business good with his lines in the countries on the other side of the Pacific.

Thomas E. Collins, manager of the detail and supply department of the Westinghouse Electric and Manufacturing Company's San Francisco office, was called to Los Angeles during the week to see his father, who was severely injured by an automobile accident.

A. K. Harford, superintendent of the Municipal Light & Power Company, has been promoted to fill the position of manager which was recently vacated by G. L. Bayley, who has accepted a position with the Panama-Pacific International Exposition Company.

J. H. Hornung has been appointed manager of the San Francisco division of the Great Western Power Company and will have charge of all the property of the City Electric Company except the steam plant, which is under the control of the general superintendent.

F. O. Blackwell, of the firm of Viele, Blackwell & Buck, consulting engineers for the Great Western Power Company, who recently spent several days at San Francisco looking over the plans for the extension of the hydroelectric system, left for the Pacific Northwest during the week.

R. J. Cantrell, property agent of the Pacific Gas & Electric Company, has returned from a visit to the scene of operations of the South Yuba construction department, where preparations are being made for the construction of a hydroelectric plant. Hydraulic monitors are being used for excavating on the face of the cliff and a large force of men is at work.

H. H. Noble, president of the Northern California Power Company, Consolidated, has returned to San Francisco from an inspection of the system. He says that one electric furnace at Heroult is in steady commercial operation on high-grade pig iron and another furnace of the latest type is under construction. **E. V. D. Johnson**, manager of the Northern California, is at Redding.

H. E. Sherman Jr. has been appointed manager of the Oakland division of the Great Western Power Company, and will have charge of all property and business in the Oakland division with the exception of the steam plant, the high-tension substations and the high-tension transmission line, lying within that district, which will be directly in charge of the general superintendent and his organization.

J. W. E. Taylor, formerly superintendent in charge of the Boulder development of the Central Colorado Power Company, and later superintendent of construction of the Yadkin River Power Company, at Pedee, N. C., is in charge of the power plant extension of the Great Western Power Company at Big Bend. Mr. Taylor's headquarters are at Las Plumas, Cal., and the field engineering and construction involved will be under his direction.

Thomas Collins of the Westinghouse Electric & Manufacturing Company's San Francisco office, delivered an interesting lecture, illustrated with moving pictures, recently, before the Ad. Men's Club in the new office building of the Great Western Power Company. The title of the lecture was "The Thrifty Family." Also some interesting slides were shown illustrating the Westinghouse shops at East Pittsburg and Newark, N. J., in operation.

G. L. Bayley has been appointed chief mechanical and electrical engineer for the Panama-Pacific Exposition Company with headquarters in the Exposition Building, San Fran-

cisco. Mr. Bayley was born in Solano County in 1875, was educated in the public schools of Oakland and entered the University of California with the class of 1897. After leaving the University he worked in the shops of the Union Iron Works for a short time and left there to go to Alaska with A. M. Hunt as his assistant in the construction of four large river steamers for the Yukon trade. After his return from Alaska he was sent by Hunt & Meredith to take charge of the construction of the Colgate power house. Shortly after the first units were put into operation he accepted an offer to go to Japan and stayed there four years, the last two years as manager of the engineering department of the American Trading Company, succeeding E. I. Dyer, now engineer for the Union Oil Company. The American Trading Company were the agents for many leading American and foreign makers of power plant, mining and railway equipment, and his work covered a wide range of engineering design and construction. He returned to America in 1904, by way of the Suez canal and Europe and engaged in the manufacturing business in Pittsburg for two years. On his return to San Francisco he was engaged to take hold of the Stanislaus project as resident engineer in charge of the construction of the power house, pipe lines, bridges and forebay dam. On completion of the Stanislaus plant he was employed by the city engineer of San Francisco in connection with the high-pressure auxiliary fire protection system now being installed. For the last three years he has been manager of the Municipal Light & Power Company of this city. He is a member of the American Society of Mechanical Engineers; the Electrical Development League, the Bohemian Club and the Faculty Club of the University of California.

GREAT WESTERN POWER.

The Great Western Power Company has issued the first number of its monthly coat-pocket magazine to deal with company affairs and the interest of its employees. Its purpose is happily expressed in the motto "One for all and all for one." Its ideals are of the highest, and following the precedent of the New York Edison Company, "It won't deal in personalities, it won't try to be funny, it won't accept advertising." The first number deals with the railroad commission hearings and decisions, a description of the motor drive in the plant of the Oakland Brewing and Malting Company, an organization chart, and short articles by several of the company officials.

TRADE NOTES.

P. G. Jones, manufacturers' agent, at 633 Howard street, San Francisco, has secured the agency for the Detroit coil, formerly manufactured by the American Fuse Company. A stock will be carried at San Francisco.

The Geary Street Railway, San Francisco, Cal., has ordered from the Westinghouse Electric & Manufacturing Company forty-three quadruple equipments of No. 306 CA motors and HL control.

The Standard Underground Cable Company, A. B. Saurman Pacific Coast manager, secured contracts for cable and other underground material, aggregating nearly $20,000 when the recent awards were made to supply the needs of the Department of Electricity during the coming fiscal year at San Francisco.

The Kellogg Switchboard & Supply Company has secured a contract for a complete control office equipment for the Juneau-Douglas Telephone Company at Juneau, Alaska. A switchboard, distributing frames and power equipment are included. The new apparatus will replace the old system in use at Juneau and surrounding territory.

George J. Henry Jr. and the Pelton Water Wheel Company were among those bidding on the hydraulic equipment for the No. 3 plant which the Southern Sierras Power Company will install at Laws to feed the long electric transmission line which has been constructed into Los Angeles territory. The specifications call for three 3000-h.p. generating units.

The General Electric Company has sold to the California Transportation Company two turbo generators for lighting installation on the steamer Fort Sutter. The ratings are as follows: One C. C. 2, 15-kw., 4500 r.p.m., 125-v. flat compound-wound Curtis turbine generating set; also one C. C. 2, 25-kw., 3600 r.p.m. 125-v., flat compound wound Curtis turbine generator set. Both units are arranged for operation on 160 pounds steam pressure, 24½ inches vacuum.

THE ENGINEERS' CLUB OF SAN FRANCISCO.

Another effort is being made to establish an engineers' club at San Francisco with the ultimate aim of performing the same functions as the New York club. The officers for the first year have been selected as follows: C. W. Merrill, president; A. H. Babcock, M. H. Peck, vice-presidents; A. M. Hunt, treasurer, and H. Foster Bain, secretary.

The following by-laws have also been adopted:

1. The name of this club shall be the Engineers' Club of San Francisco.

2. The object shall be to promote acquaintance and good fellowship among the engineers of San Francisco and elsewhere by means of weekly luncheons and in such other ways as may be determined.

3. Any member of the engineering profession or allied scientific pursuits, resident in or within fifty miles of San Francisco, shall, upon election as herein provided, be eligible to resident membership in this club.

4. Any person otherwise eligible for membership but living fifty or more miles from San Francisco shall be eligible to non-resident membership in this club.

5. Dues of resident members shall be $10 per year and of non-resident members $1 per year, each payable annually in advance.

6. Members may personally introduce guests at the luncheons and other meetings of the club, but this privilege shall be exercised under the rules of the executive committee and may be abridged or suspended by said committee at its discretion with regard to any meeting or any individual member or visitor, the latter by notice in writing signed by the secretary and addressed to such person.

7. The officers of this club shall consist of a president, two vice-presidents, a secretary, and a treasurer, who shall have the duties and powers usual to such positions and all of whom shall be elected annually to serve for one year and until their successors are elected and qualify.

8. The officers specified in Section 7 shall together constitute an executive committee, which shall have full charge of the business of the club, except as limited by the latter.

9. The executive committee shall have the power to suspend or expel any member for conduct incompatible with the interests of the club, upon giving such member reasonably previous notice of the charges preferred against him and an opportunity for a hearing. The board shall be the sole judge of what constitutes conduct incompatible with the interests of the club, except that a four-fifths vote of the committee shal be necessary to expel.

10. New members may be proposed at any time by any members and election shall be by ballot of the executive committee, a majority vote being necessary to elect; provided, that no person shall be elected until his sponsor shall have appeared in person before the executive committee to answer questions concerning the person proposed.

11. Regular meetings of the club may be held following luncheon at the Palace Hotel or elsewhere, at 12:30 p. m. each Tuesday, and special meetings at any time on call of the executive committee.

12. Amendments to these by-laws may be proposed by any member at any meeting and may be adopted by majority vote of members present at any subsequent meeting, provided they have been approved by the exeutive committee. If not approved by the executive committee, they may still be adopted by an affirmative two-thirds vote of the members present.

INDUSTRIAL

THE ELECTRIC APPLIANCE COMPANY.

The Electric Appliance Company of San Francisco was organized in June, 1904, and opened for business in San Francisco at 717-719 Mission street, near Third, where they occupied quarters comprising about 25,000 square feet of floor space. The building in which they were located and its contents were totally destroyed in the great conflagration following the earthquake of 1906. Mr. C. C. Hillis, treasurer and general manager of the company, was in New York at the time of the disaster and inside of three days had started west a new stock to take the place of the stock destroyed by the fire. This stock was temporarily housed in a large warehouse on Townsend street, at which place they suffered another loss by fire within six months of the time of the April loss. They then moved to a warehouse on Main street where they were located temporarily while their building at 726-730 Mission street was being prepared for their occupancy. These quarters were occupied for a period of five years up until May 1st of this year, when the company, on account of its large and steadily increasing business, were forced to find more commodious quarters.


General Manager's Office.


Sales Manager's Office.

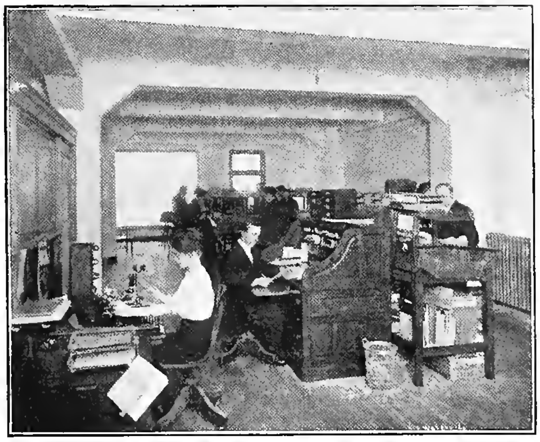
They are now at 807-809 Mission street, near Fourth, where they occupy in its entirety a six-story and basement brick and concrete Class A building, having a frontage on Mission street of forty feet and running through to Minna street, and containing close to fifty thousand square feet.

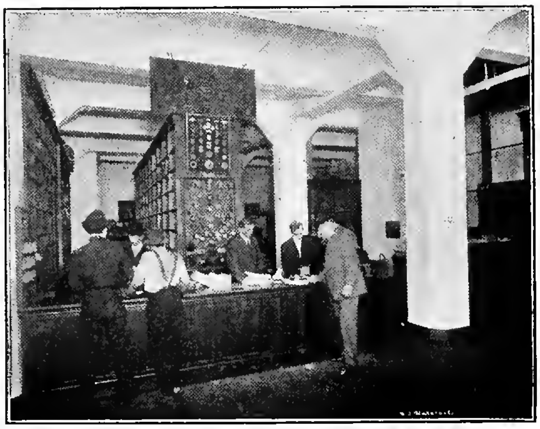
The new quarters of the Electric Appliance Company have been fitted up so as to provide every facility for maintaining the excellent service for which this company is noted. Its officers have always given special attention to details that would insure prompt shipment and satisfactory service in every department and they have surrounded themselves with a corps of assistants who have ably taken care of their work in the department over which they had jurisdiction.

The company operates over the entire Pacific Coast States, including British Columbia, Alaska, the West Coast of Mexico and the Hawaiian Islands, and has a very satisfactory and increasing business in the Orient.

The officers of the Electric Appliance Company of San Francisco are: Willard W. Low, president; Thos. I. Stacey, vice-president; C. C. Hillis, treasurer and general manager; F. J. Cram, secretary and sales manager.

W. W. Low, president, and Thos. I. Stacey, vice-president, are president and secretary and treasurer of the Electric Appliance Company of Chicago, with which this company is very closely associated. Mr. Hillis has been engaged in the electrical business for a little over twenty years and was connected with the Electric Appliance Company, Chicago, prior to the organization of the Electric Appliance Company of San Francisco. Mr. Cram has been under the Electric Appliance Company banner for about sixteen years and is known from one end of the Coast to the other.


Accounting Department.


Sales Department.

The city sales department is under the management of Albert Meinema, who is ably assisted by Grover Andersen, A. J. Dahlin, Charles Bigelow and E. E. Van Haren. T. D. Johnston is manager of the specialty department and automobile department. Charles E. Hearn, Henry F. Yost, C. J. Winslow and H. D. Havey are the traveling representatives

of the company and cover the entire Pacific Coast territory. The shipping and receiving department are under the supervision of Henry O. Sacht. Henry Zweifel is chief clerk and manager of the credit department. Albert F. Holmes is city buyer and H. R. Jenson is cashier.

In addition to the complete stock of electrical and tele-

City Sales Office.

phone supplies which the company handle, among which are many of the best known electrical specialties on the market, the Electric Appliance Company have recently added a complete stock of automobile supplies and it is the intention to carry a stock so complete that it will enable them to handle

Basement Storage.

this line of business in the same manner in which they have handled their electrical business in the past.

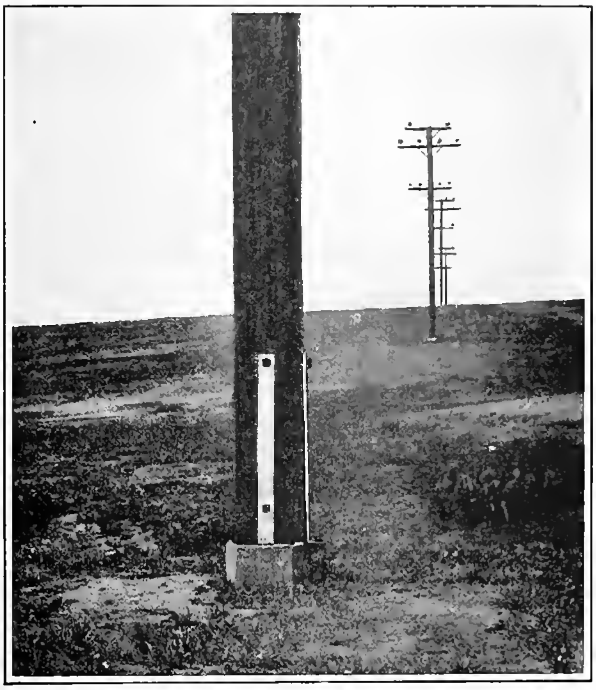
The Electric Appliance service will undoubtedly be appreciated by the automobile trade and it is to be expected, with the organization which they have, it will not be long before they occupy the foremost position in the automobile supply business which they do in the electrical supply business.

THE CONCRETE POLE BASE.

The rapid deterioration of telegraph, telephone and transmission line poles has long engaged the attention of engineers in providing some means to prevent the heavy losses ensuing. One of the most interesting and practical of the several methods proposed is the concrete stub recently patented by M. H. Murray. After severe tests as to their strength and life they have been found equally satisfactory and far more economical than wood poles and the only reliable method of preventing pole decay.

The bases are made in several standard sizes and may be used either in replacing old stubs or for new lines. In the former case the poles are sawed off about three inches above the surface, the rotted portion removed and the concrete stub inserted so that its top will reach this height, and thoroughly tamped in place. Holes are bored in the wooden pole after it is set back in place between the clamping irons, so as to obtain an exact fit; then the bolts are inserted and the job is complete as soon as the nuts are drawn up tight.

Two men have installed an average of five to six stubs per day of eight hours in rocky ground, where the stubs were distributed beforehand.



Pole With Concrete Stub.

This has been accomplished on a line carrying eleven thousand volts without interfering in any way with the operation of the line.

These concrete bases have been installed by several Pacific Coast power companies, one 50-mile, 11,000-volt line having been in service several years, the annual inspection of poles so equipped now being unnecessary and a great saving made to the company. These bases are now being manufactured and sold by the National Concrete Pole Base Company of Oakland, Cal.

SPACE-SAVING SWITCHBOARD METERS.

The increasing size of modern power developments and the growing scarcity of available space, particularly in large cities, have emphasized the need of compactness in switch-

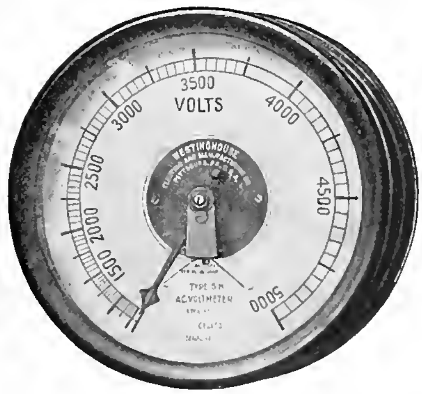


Fig. 1.

board design. The desirability of having all the meters in plain view of one operator has long been appreciated, and this requirement necessitates not only that the meters shall occupy a minimum of space, but at the same time they must be easily readable so that all can be read from a common point. In many plants, in congested districts, the switchboard is lo-

cated in a poorly lighted place, which imposes the further requirement that the meter dials be capable of thorough illumination.

To accommodate and encourage these strongly defined tendencies in switchboard design, the Westinghouse Electric and Manufacturing Co., East Pittsburgh, Pa., has developed a complete line of seven-inch, round-type switchboard meters. The size of these meters is such that three of them can be mounted in a horizontal row on a 24-inch panel, or two in a row on a 16-inch panel, whereas the ordinary 9½-inch meters and most of the better class horizontal meters require 30-inch panels for three meters in a row, or 20-inch panels for two in a row. While the resulting saving for one panel is small, the same

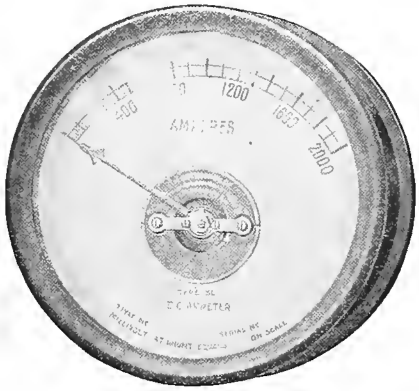


Fig. 2.

saving carried out in a whole switchboard amounts to considerable proportions. For instance, the switchboard recently installed at the Mare Island Navy Yard, using these seven-inch meters, occupies 28 feet; whereas 35 feet would have been required for the older type of meters. A proportional saving in marble, busbars and general wiring results.

A feature of a board of the character of that noted is the uniformity of appearance of all the meters. The Westinghouse line of seven-inch meters includes alternating current ammeters, voltmeters, single-phase and polyphase wattmeters, frequency meters, powerfactor meters, and synchroscopes; also direct current ammeters and voltmeters. It is the only complete and uniform line of seven-inch meters known to be on the market.

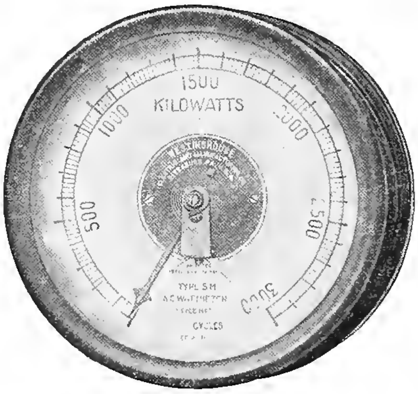


Fig. 3.

It is evident that the saving in space would mean nothing if the meters were not as easy to read as larger meters. In reality they are as easy to read as the Westinghouse 9½-inch meters, and easier to read than any other meters because of the length of their scales, the flat open faces, which permit thorough illumination, and visibility of the entire pointer, and the intense damping of the pointer.

The true measure of a meter's "space efficiency" is not alone the area it occupies, but really the length of scale per square inch of area occupied. A meter that occupies less area, but requires the operator to be closer or to move about in order to take a satisfactory reading saves little, as the number of meters that can be placed within range of the operator's vision from a given point remains the same. If, however, the same scale can be had in a smaller meter, the condensation of space is a distinct advantage. This result is obtained with the Westinghouse seven-inch meters.

The accompanying tables show a comparison of these new meters with older types, as to both length of scale and space economy for both A.C. and D.C. meters.

DIRECT CURRENT METERS.

Meter.	Height including terminals.	Width.	Area of enclosing rectangle.	Length of scale.	Sq. in. of rectangle per inch of scale.
Westinghouse 7"….	7 7/16	7 7/16	55	7"	7.85
Other 7" types……	7 7/16	7 7/16	55	5"	11
Westinghouse 9"….	11¾	9⅝	113	7.8"	14.5
Other 9" types……	11¾	9⅝	113	6"	18.8
Vertical edgewise…	15½	5 3/16	80	11.7"	6.8
Horizontal edgewise.	6	8½	51	6"	8.7
Illuminated dial…..	12 1/16	15¾	190	15.3"	12.4
ALTERNATING CURRENT METERS.					
Westinghouse 7"….	7 7/16	7 7/16	55	14.5"	3.8
Westinghouse 9"….	11¾	9⅝	113	14.5"	7.8
Other 9" types…..	11¾	9⅝	113	6"	18.8
Vertical edgewise…	15½	5 3/16	80	11.7"	6.8
Horizontal edgewise.	6	8½	51	6"	8.7
Illuminated dial…..	12 1/16	15¾	190	15.3"	12.4

A glass cover instead of a metal cover with a slot in it is a feature the advantages of which have been realized for

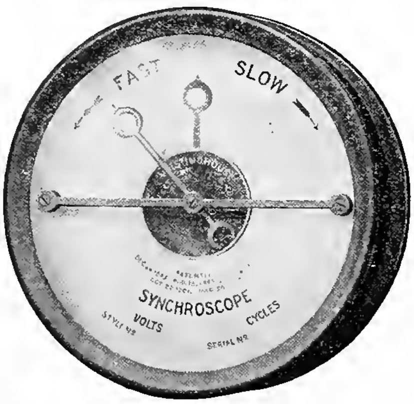


Fig. 4.

some time in European practice. The possibility of good illumination can be easily appreciated. As economy of space is most important in congested districts where poor illumination is the rule, the necessity of making the best of the illumination obtainable is evident. Added to this is the fact that the pointer, being wholly visible, can often be read by its position, like the hands of a clock. This feature is particularly valuable in immediately detecting overloads, or variations in voltage, frequency, or powerfactor on corresponding meters.

Probably no other meters on the market are equipped with such intense damping as these new meters. The meters are "superdamped"; that is, the damping is such that the pointer does not overswing and return to the true reading, but comes up to the true reading and stops. Even a variation in load equivalent to full scale will not cause the pointer to overswing. This result is accomplished in the A.C. meters, where it is especially important, by magnetic damping; an aluminum disc moving in the concentrated field of two permanent magnets. Damping of this nature is possible with these meters because they operate on the most improved form of the induction principle and are, therefore, unaffected by the fields of the permanent magnets. The torque of the meters is so high that the air dampers used in some delicate forms of meters would be entirely inadequate; and this high torque makes possible the use of correspondingly substantial control springs.

The clearness of the magnetic dampers, as well as the air gaps of the movements, are large, and accidental friction from this source is thus rendered almost impossible. The whole construction of the meter is simple and rugged, so that the initial accuracy is maintained for long periods; and repairs, when necessary, can be made by the average central station attendant without sending the meter back to the factory.

NEWS NOTES

INCORPORATIONS.

SAN DIEGO, CAL.—Hall's Sanitary Telephone Mouth Piece Company has filed articles of incorporation. The incorporators are Joseph A. Hall, S. H. Hall, Claude Woolman, A. C. Shreve and C. W. Barber. The company is capitalized at $35,000.

ILLUMINATION.

MOSCOW, IDAHO.—The University of Idaho is contemplating installing a system of ornamental lighting on the campus. Different methods are under consideration.

HEMET, CAL.—Fred B. Mechling, who purchased franchise rights to operate an electrical system in the cities of Hemet and San Jacinto, has made application to transfer the same to the Southern Sierras Power Company.

SEBASTOPOL, CAL.—The Trustees have passed an ordinance granting the Great Western Power Company permission to construct and maintain a line of poles and wires for transmitting electricity to Sebastopol, for a period of 50 years.

GILROY, CAL.—The Coast Counties Gas & Electric Company has applied for permission to purchase the capital stock of the Gilroy gas works. The price is given at $25,000. The Gilroy gas works is the assignee of the lease of the municipal plant in Gilroy.

KLAMATH FALLS, ORE.—B. E. Kerns, son of a former banker of Chico, has purchased the Thomas McCormick power plant below Keno and will start work at once building new ditches, dams and falls for power development. New machinery will be installed in August.

GLENDALE, ARIZ.—Bids have been opened for furnishing material and fixtures for the electric lighting department. The bid for $14,000 of the bond issue received from Torrance, Marshall & Company, offering par, accrued interest and premium of $382, was accepted.

WINNEMUCCA, NEV.—The people of this city want their own power, light and water plant, and for this purpose they have had the County Commissioners call a special election for August 15 for the purpose of voting on the question of a bond issue on $180,000 for the purchase of the plant of the Winnemucca Water & Light Company.

LARKSPUR, CAL.—Larkspur is to have gas within the next 60 days, says Manager Wallace Foster of the Pacific Gas & Electric Company. Just as soon as the service is introduced in Larkspur, representatives of the company will be sent to Corte Madera and Mill Valley to solicit contracts with a view of extending the mains there.

SAN FRANCISCO, CAL.—Plans have been completed for a six-story and basement building to be erected on the south side of Mission street east of Second for the Pacific States Electric Company. Among other things, the building will be equipped with an automatic sprinkler system, pneumatic tube system, two elevators and two high-speed electric hoists.

PUEBLO, COLO.—Commissioner Thomas A. Duke on the evening of June 23d, solemnly pronounced the biblical quotation, "Let there be light and there was light." Immediately a small button was pressed and forty-six clusters of fine ornamental lights burst forth on Main street. The event was spectacular and the installation will prove a great asset to the city.

SAN RAFAEL, CAL.—The Pacific Gas & Electric Company has announced another reduction in commercial and residential rates for the County of Marin, which went into effect July 1. Both commercial and residential rates are cut 2c on the former prices, with greater reductions for large consumers. Residence rates are 8c per kw. for first 30 kw.-hr. consumed in any one month; 7c for next 70 kw.hr., 6c for next 100 kw., 5c for all over. Each rate carries a minimum of $1 per month per meter installed.

SAN FRANCISCO, CAL.—The State Railroad Commission has granted the application of the San Joaquin Light & Power Company for a certificate of necessity and convenience to extend its lines into Tulare, Kern and Kings Counties. The company has a contract with the Tulare County Power Company by which it will buy its power from the latter corporation in the territory it seeks to enter. The grant of the permit was vigorously opposed by the Mt. Whitney Power Company, which now occupies the territory the San Joaquin will enter. In the decision the Commission declares the territory at issue is not completely served.

HONOLULU, T. H.—At a meeting of the stockholders of the Honolulu Gas Company the action of the board of directors in authorizing an issue of $300,000 of 5 per cent bonds was ratified. It was announced that the entire issue had already been subscribed for by local capital, which indicates what those most familiar with it think of its prospects. Two hundred thousand dollars of this amount will be used to redeem a like amount of 6 per cent bonds now outstanding. The balance will be used in extending the present plant of the growing company. The trust deed securing the bonds has been arranged. The redemption of bonds is under a sliding scale premium, beginning ten years from July 1, 1912. The company is planning to make very material extensions in its system. Ten miles of pipe for the extension to Kaimuki has already arrived.

GLENDALE, CAL.—Harry B. Lynch, manager of the electric lighting department, states that the extensive work of extending the lighting system, which has been in progress for six months, will be completed by August 1. During the last month the working force of the department has been centered on the laying of the conduits along Broadway between Glendale avenue and Brand boulevard, these being laid on account of the desire of the Trustees that all lines and poles shall be eliminated from Broadway. Throughout most of the distance on Broadway a nine-duct conduit is being laid. On Brand boulevard and Glendale avenue a three-inch fiber duct in concrete is being installed. Ornamental iron standards will be erected at intervals of 100 feet on each side of the street. Since the acquisition by the city of the West Glendale section, connections have been made to the system at the rate of about a hundred a month and the plant is serving more than 1500 customers, with probably 500 still to be connected. The fiscal year has been exceedingly prosperous for this plant. During that time the number of consumers has doubled and the price for juice has been lowered from 10 cents to 9 cents a kilowatt, with $1 minimum.

TRANSMISSION.

LOS ANGELES, CAL.—It is reported that the Nevada-California Power Company has sold $2,000,000 first mortgage 25 year 6 per cent sinking fund bonds of the Southern Sierra Power Company to Chicago bankers.

SAN LUIS OBISPO, CAL.—The Coalinga Water & Electric Company, a branch of the San Joaquin Light & Power Company, has been granted a franchise under which their lines of transmission, power plants, etc., will be operated.

OREGON, CITY, ORE.—The Clackamas Power & Irrigation Company, of which A. McColman of the Failing-McColman Company of Portland is president, is about to construct at the Hagemann power site on the Clackamas River, seven miles from here, a hydroelectric power plant of large proportions. The plans, subject to such charge as further explana-

tions may indicate to be advisable, contemplate a dam which will give a head of 60 feet. Wheels and electrical generators for the developing of 10,500 electrical horsepower will be installed at first with provision for later installation sufficient to bring the total to 17,500 horsepower. The power will be used principally for railroad purposes. The construction will be of concrete and steel, first class in every particular, and with the land to be acquired will cost upwards of $1,000,000, and will be completed by 1914.

TRANSPORTATION.

PALO ALTO, CAL.—The Peninsula Railroad Company has completed preparations to extend its Waverly line in Palo Alto to a point opposite the Mayfield depot.

EL PASO, TEX.—The Stone & Webster Engineering Corporation has purchased in Fresno supplies and material for a $4,000,000 street railway, which is to be constructed there.

MESA, ARIZ.—A franchise has been granted the Salt River Valley Railway Company to operate for a period of 25 years an electric railway system over certain streets in the town.

SAN LUIS OBISPO, CAL.—Walter G. Lincoln has been awarded a franchise to maintain for a period of 50 years a single or double track electric railroad over certain roads of the county.

CLE ELUM, WASH.—The Kittitas Railway & Power Company, Paul Richards, Tacoma, president, will start work in about 10 days building an electric line between Cle Elum and Ellensburg.

GREAT FALLS, MONT.—The Great Falls Terminal Railway Company has been organized, backed by the Milwaukee, and will construct several short lines in this city and surrounding country.

EL PASO, TEX.—The West Ysleta Townsite Company has a contract with Stone & Webster to build a substation at West Ysleta. Construction on the interurban line will begin this month.

ORANGE, CAL.—A finance committee of 50 citizens has been organized to have charge of a campaign for raising $22,000 needed to buy the right of way for the Pacific Electric extension from Santa Ana to Orange.

SAN BERNARDINO, CAL.—The citizens of Cucamonga district have started a campaign to secure right of way for the Pacific Electric's trunk line between San Bernardino and Los Angeles. It is expected between $10,000 and $20,000 will be necessary.

LORDSBURG, CAL.—The superintendent of construction for the Southern Pacific Railroad was here recently, making the trip on foot over that portion of the line which is to be electricized, for the purpose of determining the exact number of rails and bonding material necessary.

SAN DIEGO, CAL.—Although G. W. Parsell, promoter of the San Diego, Riverside and Los Angeles Railroad, was four days late in filing a $14,000 bond for an extension of time on that part of his franchise within the municipal limits, the Council probably will accept the surety.

SAN BERNARDINO, CAL.—The Pacific Electric Company has secured a 12-acre addition to the eight acres of land purchased by the city as a site for eastern terminal shops to be located here. Rights of way are being secured for the trunk line which is to be built between San Bernardino and Los Angeles.

SACRAMENTO, CAL.—The main shops of the Northern Electric Company will be moved from Chico to Sacramento as soon as a suitable site can be found and buildings erected, the Chico shops to be retained as a repair station. In view of the more or less close affiliation of interests back of the electric lines which are spreading a network over the Sacramento Valley, converging in this city, the proposed shops will be sufficient to handle the repair work of practically every interurban electric road in Northern California.

TULARE, CAL.—Frank Tvery, organizer of the Big Four Electric Railway, and J. H. Hitchcock, president of the road, have purchased from W. A. Higgins of Tulare, the entire townsite of the city of Woodville, comprising 725 acres. The consideration was $11,000. The purchase was made as an investment on the eve of beginning construction of the road to the Woodville section. Sixty teams have begun work on the Tulare-Woodville branch of the road. The grading will be completed within 45 days.

TELEPHONE AND TELEGRAPH.

LAS VEGAS, NEV.—An order has been made to the City Council directing the Consolidated Power & Telephone Company to secure a franchise to do business in this city.

DILLON, MONT.—The forestry service will commence the building of a telephone line from Argenta to Grasshopper, through the Elkhorn country, over the divide and down Wise river as far as the Swamp Creek station, a distance of about 85 miles.

LOS ANGELES, CAL.—The Postal Telegraph Cable Company has applied for a franchise to construct and maintain a conduit and pole and line system through certain streets of the city for the transaction of its business, and the Board of Public Utilities has been considering a proposed ordinance granting this franchise.

PHOENIX, ARIZ.—The Mountain States Telephone & Telegraph Company, which has lately bought out the Overland Company and Consolidated also, will be allowed to operate under order and permit issuing out of the Corporation Commission. The company will be forced to put in many additional improvements.

RIVERSIDE, CAL.—The Chamber of Commerce has again taken up the question of the consolidation of the two telephone systems in operation in this city. Since the franchise of the Pacific Telephone Company expires within a few months, and the United States Supreme Court has held that the company may not operate without a franchise, some of the members see in the situation an opportunity for bringing about an amalgamation of the Pacific and Home systems. President S. C. Evans appointed a committee consisting of Charles L. Reynolds, S. J. Castleman and S. S. Patterson to urge before the City Council the proper consolidation of the two companies.

WATERWORKS.

SPOKANE, WASH.—To make possible the plan of selling $50,000 in water main extension improvement bonds to small investors by the city treasurer at private sales. Corporation Counsel H. M. Stephens has submitted a draft of an amendment to 32 city ordinances inaugurating the water main improvements.

MOSCOW, IDAHO.—This city is to have new water mains in the recently established paving district, consisting of over 30 blocks. The pipes are to be purchased by the city, and the work done under supervision of Water Commissioner Geo. R. Carlson. The estimated cost for the pipes and laying of the same is $15,000.

HOOD RIVER, ORE.—The fruit growers of Underwood and Hood have taken steps toward organizing the Underwood Water District and have chosen G. H. Marsh president and Prof. Detwiller secretary-treasurer. A bonding system similar to the Hood River Irrigation District, is contemplated. Moss Creek, a tributary of Little White Salmon, will be tapped at an elevation of about 2000 feet. From here a gravity system can be built which will easily serve the Underwood-Cooks apple belt with an abundance of pure mountain water at a moderate expense.

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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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VOLUME XXIX | SAN FRANCISCO, JULY 27, 1912 | NUMBER 4

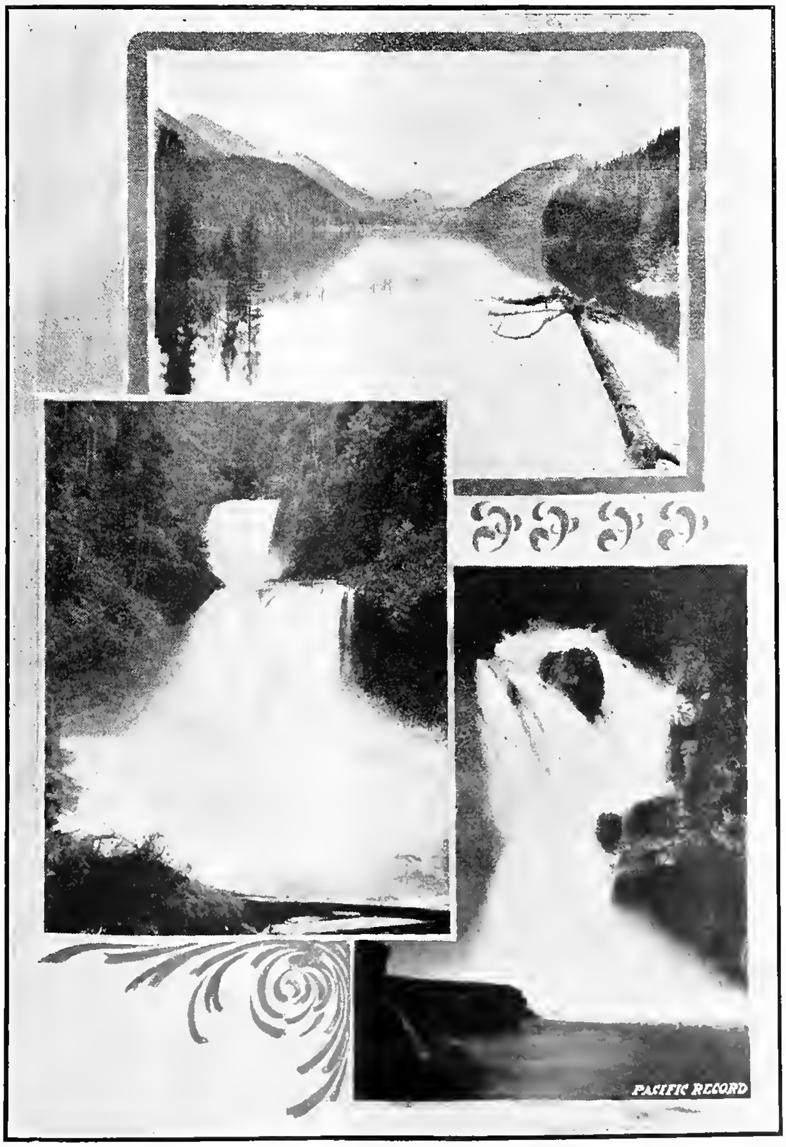
SEATTLE MUNICIPAL LIGHT AND POWER PLANT

BY J. D. ROSS.

Cedar Lake, the source of power for the Seattle municipal light and power plant, familiarly known as the City Light Plant, is situated in the Cascade Mountains, southeast of Seattle and at a distance of about 43 miles. The normal lake level lies at an elevation of 1530 ft. The lake is approximately 1.91 square miles in area and drains a watershed of 79 square miles. The mountains hold a considerable amount of their snow during the early summer and fall, and so give a more continuous flow of water throughout the year. The rainfall is enormous over this district, amounting to an average of 111.02 in. per annum at the lake level, with a greater precipitation at high elevations, due to the greater chilling of the clouds in passing over the mountains.

The lake discharges at its northerly end into Cedar River, a swift mountain stream which, after tumbling through rapids and cascades, between rocky walls for 3½ miles, reaches a valley over 600 ft. below the lake level. At this point the generating station of the City Light Plant is situated.

In order to supply power for the generating station, a rock filled timber dam 250 ft. across was constructed in the river about three-quarters of a mile from Cedar Lake, raising the original lake level 18 ft. This dam impounds sufficient water to operate the plant with its present needs for 40 days in dry weather, without considering the natural inflow during this time.



Cedar Lake and Upper and Lower Falls

From the control gates at the dam two pipes, one 48 in. and one 68 in. are laid to carry the water to the plant below. These pipes are built of wood staves banded with steel for a distance of approximately 15,400 ft.; the remainder of the distance, about 1000 ft. is constructed of riveted steel pipe. Both pipes are almost entirely underground covered with 18 in. of earth. The combined maximum capacity of these two pipes is 14,000 h.p.

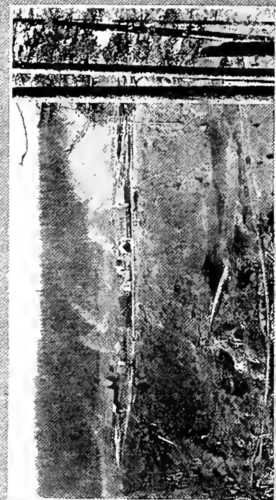
The power house contains generators of a total maximum capacity of 18,000 h.p., all of which can be utilized by providing an additional pipe and some additional storage. To complete the plant and develop its ultimate capacity it is necessary to impound the entire run-off of the watershed. To this end a concrete dam is being con-

MASONRY DAM SITE

THE CITY OF SEATTLE

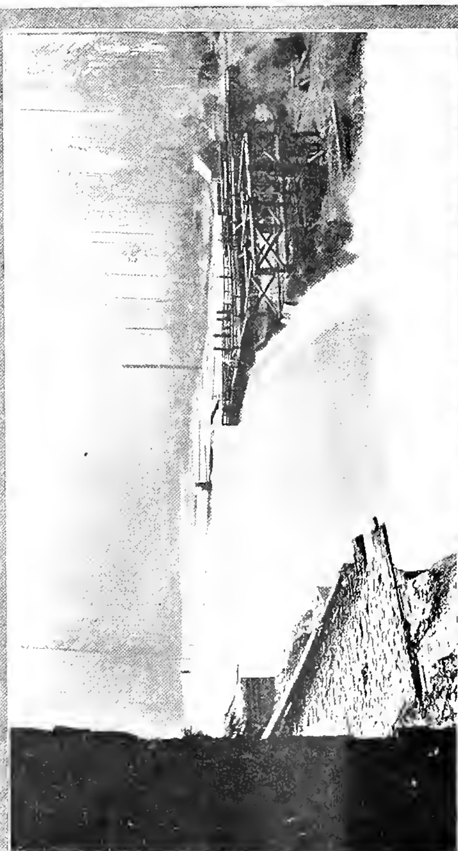
TOTAL HEIGHT OF PROPOSED DAM 202 ft
LENGTH ALONG THE TOP OF DAM 640 ft
DEPTH OF FOUNDATION BELOW RIVER BED 40 ft
EL. OF TOP OF DAM 1600 ft ABOVE SEA LEVEL
ORIGINAL ELEVATION OF LAKE 1530 ft AB. SEA LEV
PRESENT " " " 1550 ft " " "
PROPOSED " " " 1600 ft " " "
AREA OF WATER SHED ABOVE THIS POINT 84 sq mi

SITE OF NEW CONCRETE DAM



LOOKING ACROSS SITE OF NEW DAM

SHOWING CROSSING OF PIPELINE No 1&2



CEDAR LAKE DAM WITH 9 FEET OF WATER OVER CREST

6 FT. PIPE LINE FROM CEDAR LAKE TO SEATTLE CITY LIGHT POWER PLANT

structed at a point in Cedar River 2¼ miles below the lake. This dam will be 720 ft. long and 215 ft. high and will raise the original lake level 75 ft., or an additional 58 ft. above the crest of the present dam, and will increase the size of Cedar Lake to 5.23 square miles. The total power available after this work is done will be 14,950 kw. continuous every hour of the year. The average load for the year in the city plant will probably be about 40 per cent of the maximum load, and consequently the machinery which can be operated from the new reservoir will be not less than 37,400 kw., measured on the switchboard at Cedar Falls Station. This is a very conservative estimate.

Cedar River is also the source of the city water supply and the new dam will greatly increase the capacity of the water system as well as of the lighting system. The water is remarkably pure and clear, and in order to maintain the best sanitary conditions an enormous amount of timber is being cut and cleared off from the area to be overflowed by the lake when the new dam is completed.

The city power plant is situated near the town of Cedar Falls, on the Chicago, Milwaukee & Puget Sound Railway.

The generators at the power house, four in number, are direct connected to water wheels, two of which are turbines and two impulse wheels, the whole being set on solid bed rock. The wheels discharge into Cedar River. The city has provided six modern houses for its employees at the power station. Sanitation is carefully observed and all sewage is carried away from Cedar River to the Snoqualmie watershed.

Current is generated at the power house at 2300 volts, and stepped up to 60,000 volts for transmission to Seattle. Two entirely separate lines are used for added security to the service. These lines are each 38.7 miles in length and come over private right of way for the entire distance. All timber that could fall and touch the lines has been cut. A line patrolman is stationed at Landsberg and one at Renton. These lines enter the Seattle substation at Seventh avenue and Yesler Way, where the voltage is stepped down to 7500 and 2500 for city distribution.

The distributing system includes 17,600 poles and 3661 miles of wire operating in connection with 1159 transformers, supplying approximately 20,000 customers, besides a street system consisting of 692 arc lamps, 199, 300 and 350-c.p. and 5315 40-c.p. series tungsten lamps lighting 601 miles of street, and 1631 ornamental iron cluster light poles lighting 25 miles of street. Of these poles 1116 carry five globes, 378 carry three globes, and 137 carry one globe each.

Dam and Head Gates.

The dam is 250 ft. wide and is constructed of timber cribs filled with rock. The foundations and wings are dug deep into a sand formation, there being no rock in the vicinity. The dam was completed in 1904, the intention being to build a large concrete dam one and one-half miles below this point, where rock foundations could be got, as soon as the size and success of the plant would warrant the ultimate development. The new dam is now in process of construction. The south wing of the timber dam carries the head gates for the two pipe lines which supply the plant. The spillway is placed in the centre of the dam. This dam has done remarkably good service, taking care of floods nine feet over the spillway without difficulty or damage other than the breaking during 1911 of part of a 4.8 ft. superstructure on the spillway, which was not a part of the dam proper.

Pipe Lines and Penstocks.

From the dam two wood stave pipe lines lead out to supply the water wheels at the power house. One of these pipes, built in 1904, is 49 inches inside diameter built of 30 staves 1 9/16 in. thick from 2 in. x 6 in. stock. The other pipe, built in 1908, is 67¾ in. inside diameter, built of 30 staves 2¼ in. thick from 2½ in. x 8 in. stock, and banded for a factor of safety of four. These pipes are buried under 18 in. of earth and rock on account of the heavy timber through which they pass. The highest head under which the wood stave pipe operates is 310 ft. The sharpest curve used in wood stave is 18 degrees. Sharper angles than it was possible to turn with this radius of curvature were made by using riveted steel elbows of 15 ft. radius. Five of these elbows from 45 degrees to 90 degrees are used in the larger pipe. At a point 951 ft. from the power house and under a head of 310 ft., the larger pipe branches through a Y and two 48 in. valves into two 48-in. riveted steel pipes. The total length of the larger wood stave pipe is 15,865 ft. making the entire pipe line 16,816 ft. in length. At a pocket 1008 ft. from the power house the smaller wood pipe also connects to a 48-in. riveted steel pipe. The total length of the smaller wood pipe is 15,407 ft., making the total length of this pipe line 16,415 ft. A factor of safety of five is used on the steel pipe.

At the power house an interconnecting system with valves is arranged such that any one of the three pipes may be used on any of the four machines and the pipes are normally left with these valves open to equalize water ram and better the regulation.

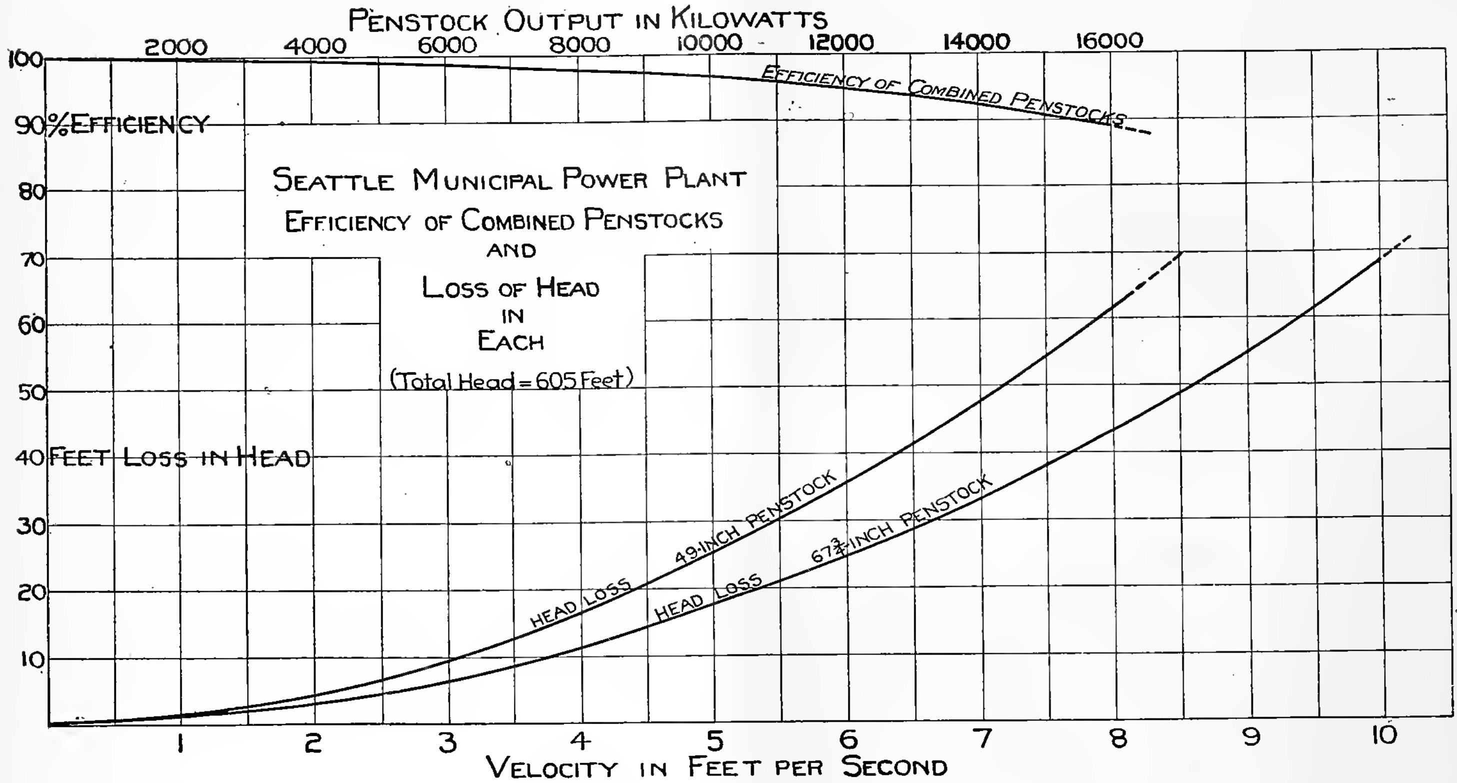
A 30-in. steel standpipe is placed on the hill approximately 3600 ft. from the power house on each pipe to further decrease the effect from ram and danger of collapse. These pipes are 65 ft. and 70 ft. in height respectively on the smaller and larger pipe. Smaller standpipes and air valves are placed at a number of points along both lines.

The maximum static head on these pipe lines with reservoir full including 3 ft. of flash boards is 614 ft. The all-day efficiency of the two pipes working in multiple for the year 1911 computed from recording gauges was 97.9 per cent. A careful test was made of the 67¾-in. pipe with the following results:

Velocity in Feet Per Second	Loss in Entry and Screens	Elbow No. 1 92 Degrees.	Elbow No. 2 55 Degrees	Elbow No. 3 60 Degrees	Elbow No. 4 65 Degrees	Elbow No. 5 45 Degrees	Total Loss in Pipe	Friction Loss After Deducting Entry and Elbows	Loss in 67¾ Inch Stave Pipe Per 1000	Value of C in Kutters Formula	Value of N in Kutters Formula
2½	.06	.03	.03	.03	.03	.01	4.1	3.91	.246	134.06	.01190
5	.25	.09	.08	.08	.08	.05	15.4	14.77	.931	137.96	.01175
7½	.54	.25	.18	.19	.20	.14	33.9	32.40	2.0425	139.71	.01165
10	1.14	.46	.34	.36	.37	.27	61.9	58.96	3.775	137.01	.011865

This pipe has been in operation since November 20th, 1908.

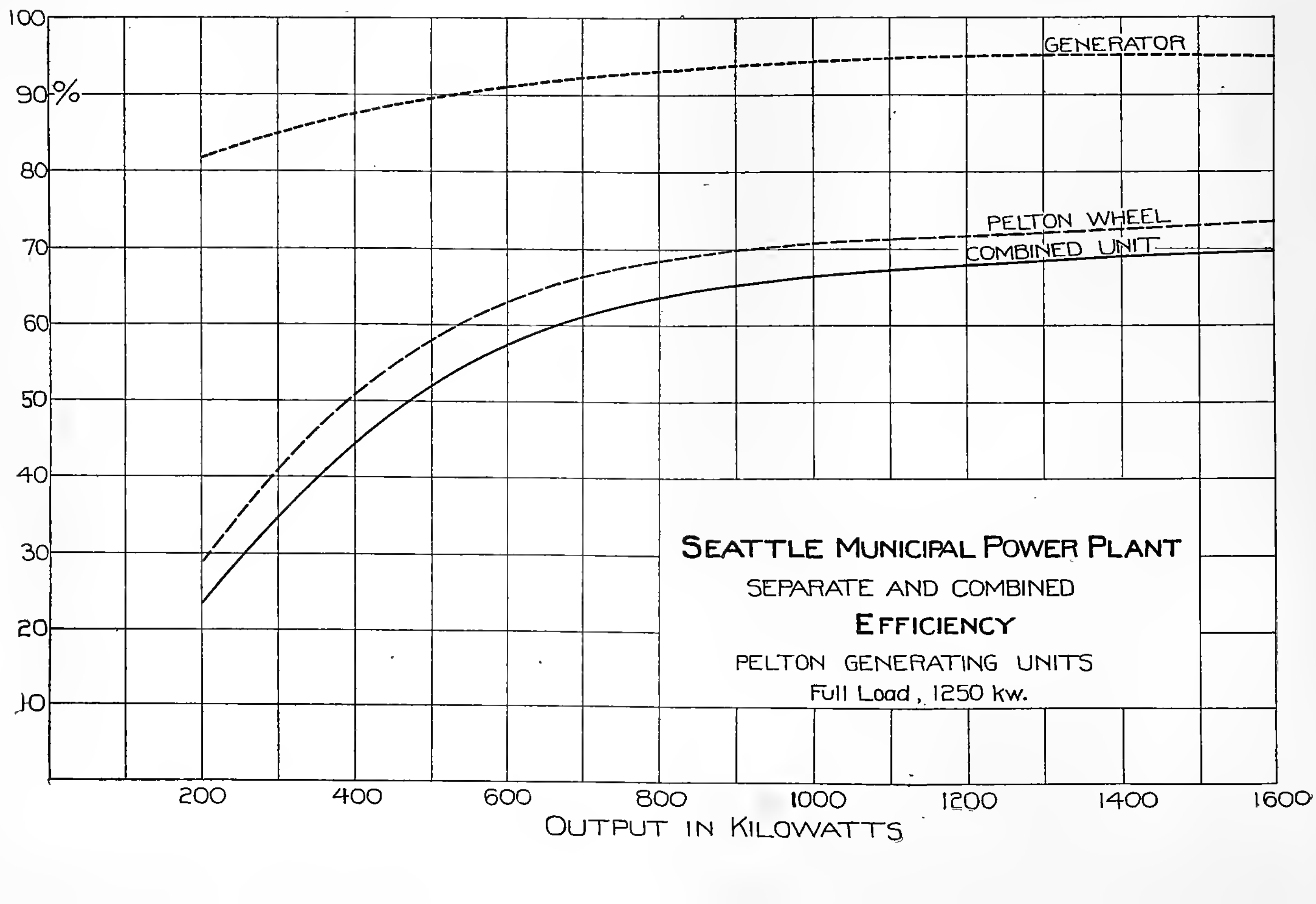
The loss in entry as given in the above table seems large and rises with the velocity more rapidly



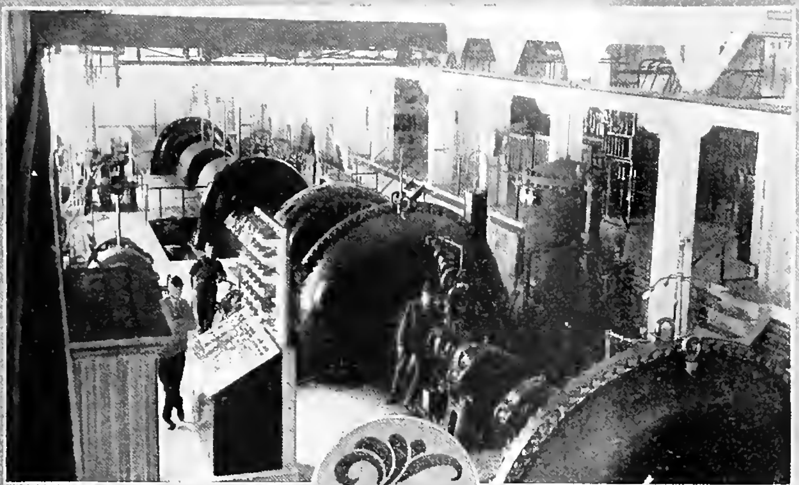
than it should. This is apparently due to the resistance of the screens which are of wood bars. These were being changed before the test was made as it was noticed at times of heavy load that there was a difference of level on the two sides of the screens. The entry of the pipe is bell-mouthed. The line was designed for a slope of 4 ft. per thousand ft. to give a velocity of 10 ft. per second.

Generating Station.

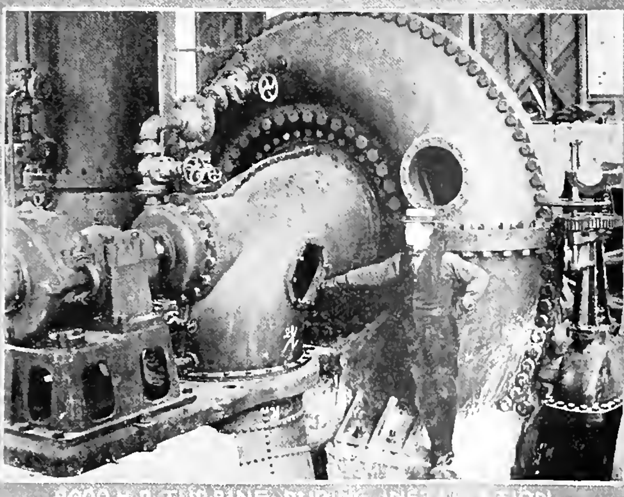
There are four units in the power house, two of which consist of 8000 h.p. Platt Iron Works Francis turbines direct connected to Westinghouse 60 cycle 2300 volt, 3-phase generators rated at 4000 kw. at 35 degrees C. rise with a four hour overload of 5000 kw. capacity for four hours at 40 degrees C. rise. These units operate at 600 r.p.m. The other two units



EXTERIOR OF POW[illegible] R. FALLS



INTERIOR OF POWER HOUSE



8000 H.P. TURBINE DURING INSTALLATION

are driven by 2400 h.p. Pelton impulse wheels direct connected to Bullock 60 cycle 2300 volt, 3-phase generators rated at 1200 kw. at 35 degrees C. rise, with a four hour overload capacity of 1500 kw. at 40 degrees C. rise. These units operate at 400 r.p.m. The wheels are each equipped with two runners, each of which is supplied from a needle and a deflecting nozzle. The combined capacity of the present installation is therefore 13,000 kw. on a 40 degree rating. The Bullock machines, however, exceed their rating and have been operated continuously without excessive heating at 1750 kw., making the combined capacity 13,500 kw. Three water wheel exciter units are installed, two of which have a capacity of 75 kw. each, and the third 150 kw.

A careful test of turbines, impulse wheels and generators has been made to compute the losses in each. In making these tests the generator losses at all loads were first obtained, after which the wheel efficiency was obtained by measuring the water over a weir built in the tail race, the results being very carefully checked by a current meter. In all over 200 readings were taken to get the most accurate results. The output was measured at the terminals of the generator.

As the efficiency of each unit varies with the load and it is obviously impossible to have all generators that are in use at any time carry their full load, the all day efficiency of the generating station will depend on the number of units in use and the load which each carries as well as the power factor of the load, and in the case of our plant, where two types of wheels are used, it will also depend on the proportion of the load that the operator gives to each type of machine. In general, the greatest all day efficiency can be had by keeping the machines as nearly as possible at the load of maximum efficiency, and by shutting down the machines without load as far as can conveniently be done.

In this plant we have to deal with a three and one-half mile pipe line with the only place suitable for a standpipe 3600 ft. from the wheels, and conditions are made more difficult by the fact that they are operating under 600-foot head and 74 per cent of the plant capacity is turbine driven. The objection to turbines for regulation is very largely overcome by the use of relief valves, which work satisfactorily.

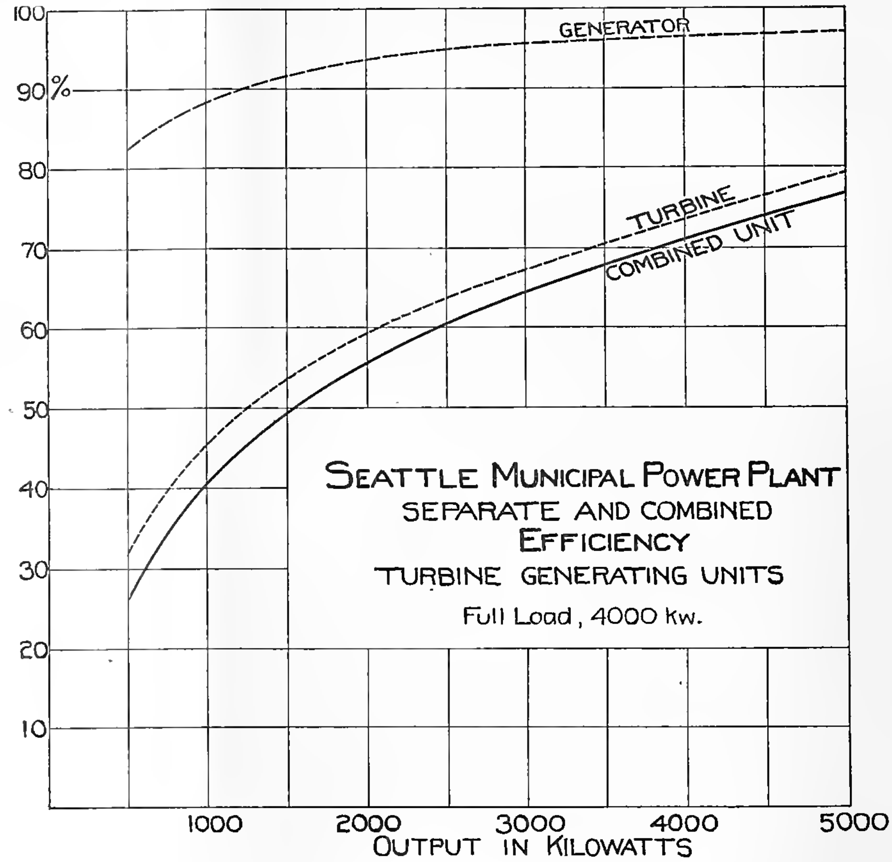
The all-day efficiency was computed from the half-hour readings of each unit as shown by the daily reports of the station, and the results checked against the watt hour meters. This study brought out the important fact that in determining the amount of power in a reservoir the efficiency ordinarily assumed for the power units is much too high and misleading. While the combined maximum efficiency of generator and wheel was found in the case of the 5000 kw. units to be 76.7 per cent and in the case of the 1500 kw. units to be 69.9 per cent, the all-day efficiency of the plant for 1911 was found to be 56.7 per cent. This does not include current for excitation and station lighting. By including this as a loss, the all-day efficiency of the plant drops to 55.7 per cent.

The all-day efficiency of the impulse wheels was 65.8 and 61.1, and the turbine units 53.1 and 50.8. The reason for the differences in the same type of unit is found in the fact that the operators favor No. 1 and

No. 4 machines, from habit rather than intention. The impulse wheels being small are operated under full load for a great part of the day and their all-day efficiency is greater than that of the turbines, notwithstanding the higher efficiency of the turbine sets at full load. It will be readily seen from these facts that the efficiency of a plant depends very largely on the way it is handled by the operator and during low water periods it is possible to prepare a schedule showing which machines should be used for each load which the plant carries. This schedule will be modified by the conditions of the plant, changes in load, and regulation.

The excitation for the entire plant for 1911 has been an average of 45.5 kw. and 1.39 per cent of the output of the machines in kw.-hrs.

The governing of the wheels is done by type N Lombard governors and synchronous relief valves in the case of the turbines and by Lombard-Replogle mechanical governors in the case of the impulse wheels. The latter governors act on the deflecting nozzles and on a deflecting hood on the needle nozzles.



Station Control Board and Wiring.

The control board resembles a bench board and has all water wheels, governors, generators, exciters, busses, transformers and switches represented in the relation they bear to each other. The different machinery is represented in gun metal finish; the d.c. exciter system and bus in nickel; the 2300 volt system and busses in brass, and the 60,000 volt system, busses and lines in copper. Signal lights and bulls'eye lenses are used for all switches.

The control for the station for switches and motors is 125 volt from a separate 25 kw. generator direct connected to an overhung Pelton wheel and having a flywheel on the other end of the shaft. Arrangement is made for the control of all rheostats, switches, valves and governors by motors or solenoids and as the board is only 72 inches by 36 inches, the entire station is well under the control of one operator.

The measuring and synchronizing instruments are grouped directly in front of the control boards, being placed on vertical panels of blue Alaska marble. All instruments, both direct current and alternating current, are of the horizontal edgewise type. The oil switches and busses are placed in concrete cells and all 2300 volt connections and busses are heavily wrapped with empire cloth and varnished. Beside the 60,000 volt selector switches, there are in a separate stone building two main 60,000 volt electrically operated oil switches capable of opening under any conditions. Open air switches in multiple with the oil switches are arranged for closing during repair or accident to the oil switches without interrupting the line.

The Department makes in its own shops all its 60,000 volt switches, both air and oil break, and all switchboards, measuring transformers, both potential and series, overload relays, and special apparatus.

Step-Up Transformers.

The station is equipped with nine Fort Wayne transformers arranged in concrete cells in three banks, one bank to each cell. Each bank has a normal capacity of 4500 kw. at 35 deg. C. temperature rise. These transformers step the voltage from 2300 to 60,000 volts three phase star connected. All high tension wiring is done on iron pipe framework using metal pins. The neutral of the star connection is grounded.

These transformers were carefully tested and the all-day efficiencies computed. The maximum efficiency at full load showed 98.6 per cent and the all-day efficiency during 1911 showed 96.1. All these tranformers were in circuit continually to keep them in good condition and their core losses were continuous. They are insulated with solid ⅛-inch micanite partitions and molded mica channels on coils next to the iron core. The result of this extra insulation is that the operation of these transformers since their installation has been under all conditions all that could be desired.

[The foregoing description is taken from the Annual Report of the Lighting Department and will be concluded in succeeding issues.]

According to the report of W. H. Storms, State Mineralogist, hydro-carbons, including petroleum, natural gas, bituminous rock, exclusive of asphalt and all other refined products, to the value of $41,161,226 were produced in California during 1911. The output is divided as follows:

Petroleum; sold in 1911, or in storage December 31	$37,920,820
Petroleum; used as fuel in the field	2,631,268

PHOTOGRAPHY IN ENGINEERING

BY M. R. LOTT.

Bromide Enlargements.

For exhibition purposes it is often desirable to show pictures in a larger size than those made directly from the negative. Pleasing results are best obtained by the use of bromide enlargements, in which detail is preserved to a remarkable degree. Truly beautiful pictures result from enlarging from landscape negatives, especially if the prints made are redeveloped and given a sepia tone. Bromide paper is best adapted for making enlargement, but as it is very sensitive to the light extreme caution must be observed while handling it.

In the arrangement of the printing room given in Figs. 1 and 2 provision is made for making enlargements by daylight. Should it happen that the north window does not have an unobstructed view of the horizon, light may be reflected from the sky by placing a white surface at an angle of 45 deg. with the horizontal outside the window.

If the negative to be enlarged is on a glass plate, it may be slipped in the plate-holder attached to the window opening as it is, but if the negative is on a film it may be held flat by placing it between two clear glass plates, the combination being slipped into the plate-holder. The camera back is opened up and the camera attached to the device at the window opening. Support is furnished by a small stand placed on the work table. The camera shutter should be fully opened to permit sufficient light to pass through for easy focusing of the image on the screen. The size of the enlargment depends upon the focus of the lens and the distance of the screen from the negative. The farther away the screen is placed, the larger will be the size of the picture. When the size of enlargement is obtained by shifting the screen back and forth, the image is brought sharply into focus by racking the lens. Focus should be first secured on white paper placed on the screen, then the diaphragm shut down to about stop 16 (U. S. system) in order that the image may be sharply defined. The shutter is then closed and the bromide paper attached to the screen by thumb tacks. In order to best judge the time of exposure to be given it is well to use a narrow test strip of bromide paper placed diagonally across the screen giving different parts of the strip different lengths of exposure.

The processes of development, fixing and washing are practically the same as for ordinary velox prints, though slightly different solutions are used. The formulas for this will be found in the next issue of the Journal.

Mixing of Solutions.

As a rule it will be found cheaper and more convenient to mix the solutions used, for one is then able to vary the different chemicals to suit his own purposes.

In order to mix chemicals there must be a pair of balances for weighing, a vessel (enameled ware) for mixing and means for heating the water used. Distilled water costs very little and its use elminates many of the troubles which might occur in development.

The apothecaries system of weights and measures is used except in the preparation of solutions according to the directions given by the Eastman Kodak Company. These latter are mixed according to avoirdupois weights.

Apothecaries' Weight—		Avoirdupois Weight—	
1 scruple	= 20 grains	1 drachm	= 27.34 grains
1 drachm	= 60 grains	1 ounce	= 437.5 grains
1 ounce	= 480 grains	1 pound	= 7000.00 grains
1 pound	= 5760 grains		

The following relation exists between the powdered and crystalline states:

2 oz. Sulphite of Soda (dessicated) = 4 oz. crystal
2 oz. Carbonate of Soda (dessicated) = 5 oz. crystal

Most of the chemicals used are extremely poisonous, consequently they should be so labeled and treated accordingly.

Chemical Mixing Appliances.

Formulas.

The following formulas have been selected from those given by different photographic firms and are those which have been found by trial to yield the best results.

Cramers X-Ray Developer.

This developer is an excellent one to use for negatives taken of drawings, for it produces very clear high lights. With this solution, plates should be developed till practically none of the image can be seen when held before the ruby light for the purpose of looking through. Development for a properly exposed plate lasts about 15 minutes.

The developer may be mixed in the quantity given by the formulas and kept in bottles for use. The chemicals must be dissolved in the order named.

APOTHECARIES' WEIGHTS.

Solution A.

Water	32	ounces
Hydrochinon	1½	ounces
Sodium Sulphite (dessicated)	1	ounce
Sulphuric Acid	60	minims

Solution B.

Water	32	ounces
Sodium Carbonate (dessicated)	1	ounce
Potassium Carbonate (dessicated)	3	ounces
Potassium Bromide	120	grains
Sodium Sulphite (dessicated)	3	ounces

To use take equal parts of A and B

Eastmans Developer for Plates and Films.

This is an excellent developer to use with plates and films when it is desired to bring out the detail.

AVOIRDUPOIS WEIGHTS.

Pyrogallic Acid	5 grains
Sulphite of Soda (dessicated)	35 grains
Water	8 ounces
Eastman's M. Q. developer, stock solution	½ ounce

Eastmans Pyro Developer.

This developer gives good results where detail is desired, but does not keep especially well. It is used for plates or films.

AVOIRDUPOIS WEIGHTS.

Solution A.

Pyrogallic Acid	484 grains
Oxalic Acid	12 grains
Water	11 ounces

Solution B.

Sulphite of Soda (dessicated)	3 oz. + 12 grains
Carbonate of Soda (dessicated)	2 oz. + 8 grains
Water	77 oz.

To use take 1 part A
7 part B
12 part Water

Dissolve in the order named:

Water	11 oz.
Hypo	1 oz.
Sulphuric Acid	1/6 oz.
Chrome Alum	2/3 oz.

Chrome Alum Fixing Solution.

This solution is an emerald green in color and has the property of remaining clear throughout its period of usefulness. The chrome alum is used to harden the film, thus preventing frilling.

THE DIESEL ENGINE.

Although the steam turbine has superseded the reciprocating steam engine for the generation of electricity in central-station work, and will probably hold the field for some time to come, R. H. Fernald finds it interesting to note in Technical Paper No. 9 of the Bureau of Mines, that the Diesel engine, owing to its great success in small station work, is looked upon seriously as a proximate possible rival to the steam turbine. In a paper recently presented before the Municipal Electrical Association at Brighton, England, the relative cost of a 10,000-kilowatt installation for steam turbines, gas producers and engines, and Diesel engines, was discussed at length. The author proposed the use of seven sets each of 1450-kilowatt capacity. His figures of operating expense, etc., are decidedly in favor of the Diesel-engine installation.

Attention was also called to the very economical use of these engines as a substitute for substation converting machinery. Such stations are already appearing in London.

In this connection the increase in the size of the Diesel-engine is worthy of note. Engines of a few hundred horsepower have become common in Europe. In Swiss electric stations Diesel-engine units of 2000 h.p. are now in use, and one writer states that the development of the large-sized Diesel engine has been so successful that it will not be long before 1000 h.p. developed in one cylinder will be deemed nothing extraordinary. One company of world-wide reputation is at present considering more than 2000 h.p. in the single cylinder of Diesel engines. It is stated that engines of this type with four cylinders, developing 1000 h.p. each, can be made as light as the corresponding triple-expansion steam engine.

The weight of such engines compares favorably with that of the corresponding turbines and boilers. It is understood that a 1000-h.p. installation of this type weighed only 187 lb. per h.p. as compared with 180 lb. for a steam turbine and boiler installation.

The crude-oil engine is now definitely under consideration for all types of marine craft. For small vessels the advantage lies in the safety afforded by the use of crude oil as compared with lighter oils. The crude-oil engine is being used by many of the principal navies of the world for submarine boats, and designs are already under way for comparatively large engines for torpedo boats and other similar craft.

A few months ago the Vulcanus, a vessel of 1900 tons displacement, 196 feet long, equipped with six-cylinder four-cycle single-acting reversible Diesel engines, was put in regular service between Holland and Borneo. This engine is about 500-brake h.p. capacity at 180 revolutions per minute. The fuel is a crude oil from Borneo, and the quoted guaranties are 0.42 lb. per brake h.p. hour at full speed; 0.44 lb. at three-quarters speed; and 0.5 lb. at half speed. In a recent trip the Vulcanus covered 3312 miles in 19 days and 3 hours. The average speeds varied from 6.86 to 7.80 knots. It is reported that the average consumption for this ship amounts to one ton of fuel oil per 100 knots.

The technical journals of recent date record many such installations. Among these Russia is credited with at least four freight vessels of 1000 h.p. and two 14-knot gunboats of the same horsepower rating. In December, 1911, two vessels, nearly 400 ft. long and of 7000 tons capacity, each fitted with Diesel engines of 2500 h.p. rating and with two auxiliary Diesel engines aggregating 500 h.p., were being tried out in European waters.

The attention of marine engineers is especially directed to the most recent development in the oil-engine field—the Junkers oil engine. These engines for the freight vessel of the Hamburg-American Line are of the twin-tandem type of 1600 total shaft h.p each. The engines operate on the two-cycle principle, and through the introduction of two pistons into each cylinder double action is obtained.

An interesting comparison will shortly be placed before the public by the British Admiralty, which proposes to try out side by side in a twin-screw cruiser a steam engine and a Diesel engine of 6000 h.p. rating.

A destroyer recently ordered by the British Admiralty, according to current reports, will have on each shaft a steam turbine and a Diesel engine. The plan is to operate the turbines when high speeds are required, but, under cruising conditions, when the speeds are low, owing to the poor economy of the steam turbines, the Diesel engines will be used. The combined economy from this arrangement will be ex-exceedingly interesting.

One of the interesting features of engine development is the fact that there seems to be a marked tendency toward the two-stroke cycle for marine work.

With the introduction of internal-combustion engines the discomforts of the stokehole will be greatly reduced, the labor required will be less than under present marine conditions, and the character of the labor will be much improved.

GRAPHIC REPRESENTATION OF ELECTRIC RATES.

BY H. E. EISENMENGER.

(Concluded)

Some central stations leave the customer the option between two or more different rates. We have then to consider for each customer only that rate which gives him the lowest bill, and the model for the combination of the optional rates will be a combination of the models of the opinional rates in such a way that only that surface is selected which has the smallest ordinate for the respective customers' point p. To show this in a sample example, let us assume the two optional rates would be:

(a) A straight 12c per kw.-hr. rate

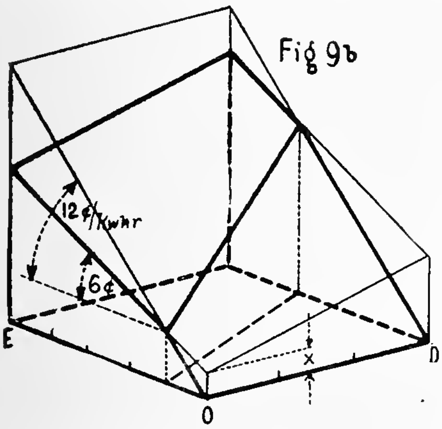
(b) A rate under which each customer has to pay $1.80 for each kw. of his maximum demand, and on top of this 6c per kw.-hr.

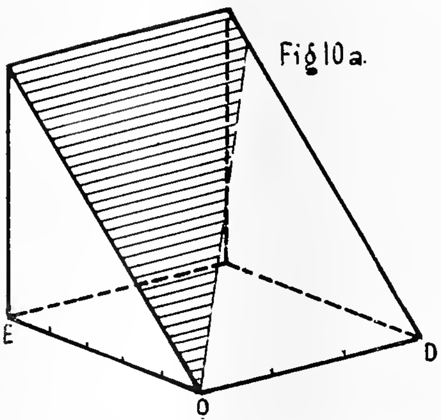
These two rates are represented by Figs. 10 a and 10 b, and it can be readily seen that if combined in the manner indicated they will result in Fig. 8 b. (The shaded areas in Figs. 10 a and 10 b are those parts of the surfaces which do not apply, being higher than the corresponding part of the other optional surface.) Therefore, the multiple rate described in Fig. 8 b is identical with the system of optional rates just mentioned.

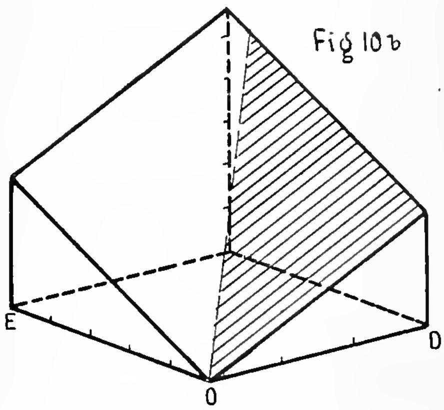
The eminent usefulness of a proper rate analysis is clearly demonstrated in the following example, which is taken from actual practice.[1] Under this rate the consumer had to pay a certain monthly fixed charge f cents per kw. maximum demand; let us say $4.00 per kw. (f = 400). This entitles him to use current up to the load factor L; (for instance, L = 300 hours' use of the maximum demand) the excess to be paid at z cents per kw.-hr. (for instance, 2½c per kw.-hr.). Without mathematical analysis, this rate looks perfectly correct and harmless, and it was not until the customers, themselves, happened to find out the defects and took advantage thereof, that the rate was revoked. With a little mathematical analysis, as follows, or a construction of a model, the defects of the rate would have shown up glaringly at once, and the rate would never have been put into effect.

In the range of load factors smaller than L hours (300 hours) we have a = f d, where a is again the customer's bill, and d his maximum demand; and if L is larger than 300, the customer with a total energy consumption of e kw.-hrs. has to pay, on top of this, for the excess of e over L d kw.-hrs. at the rate of 2.5c per kw.-hr., so that his total bill will be:

$$a = f\,d + (e - L\,d)\,z$$
$$= (f - L\,z)\,d + e\,z \quad\ldots\ldots\ldots\ldots\ldots\ldots(1)$$







The first term on the right side is proportional to d, and independent of e; the second proportional to e, and independent of d. Consequently, f — L z is the equivalent demand charge, and z is the equivalent energy charge in the range of load factors larger than L hours.

Substituting now the above values from the schedule for f, L and z, we get

$$a = (400 - 300 \times 2.5)\,d + 2.5\,e$$
$$= -350\,d + 2.5\,e.$$

We have a **negative** demand charge of $3.50 per kw.! In other words, all the customer has to do, in order to reduce his bill—provided he has a load factor of more than 300 hours' use per month—is to **increase** his maximum demand before the meter reader comes, and he will get a reward of $3.50 for each kw. of increased demand, until he has reduced his load factor to 300 hours per month. For instance, let us assume his demand meter reads 50 kw. at the end of the month, and his kw.-hr. meter 30,000 kw.-hrs.; his bill therefore would be

$$50 \times 400 = 20{,}000c$$
$$(30{,}000 - 50 \times 300) \times 2\tfrac{1}{2} = 37{,}500$$
$$\overline{\phantom{57{,}500c}}$$
$$57{,}500c = \$575.00$$

If he now, before the meter reader comes, for a short time on purpose puts on a heavy load on his motors, or for instance lets them all work simultaneously (instead of the diversity they show under ordinary operation) and thus runs his maximum demand meter up to 80 kw. with a practically unchanged kw.-hr. consumption, he will have to pay

$$80 \times 400 = 32{,}000c$$
$$(30{,}000 - 80 \times 300) \times 2\tfrac{1}{2} = 15{,}000$$
$$\overline{\phantom{47{,}000c}}$$
$$47{,}000c = \$470.00$$

He has increased his demand by 30 kw.; therefore his bill must be smaller by 30 × $3.50 = $1.05. This reduction of the bill with increasing maximum demand of course goes on until his load factor is reduced to 300 hours.

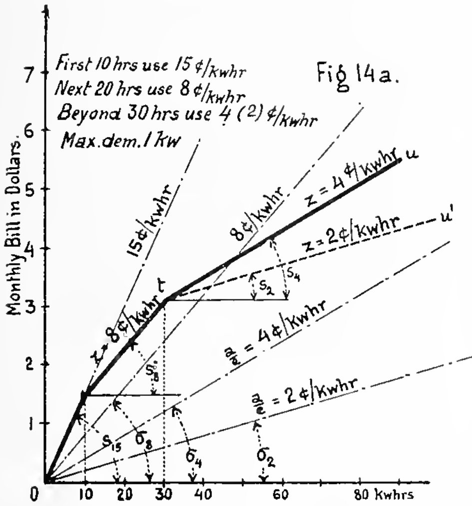
The model of this rate as given in Fig. 11, where the fact that the plane O S T is sloping downwards with increasing demands d instead of upwards, indicates that the angle r is negative, and that therefore

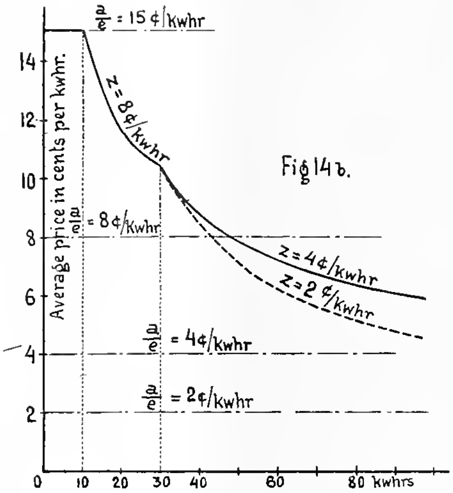
[1]The figures are changed for obvious reasons, but in such a way that the characteristic features of the rates are preserved.

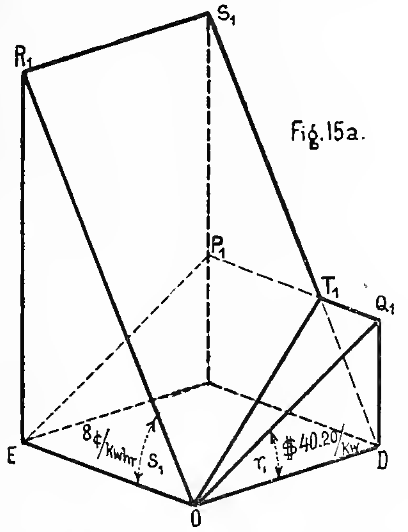
the demand charge $y = \tan r$ is also negative.

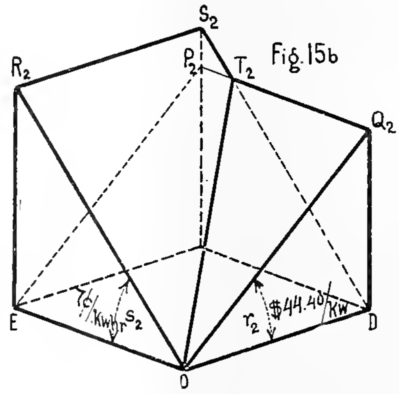
In order to correct this defect we would have to choose the constants f, L and z so that $f > Lz$ (see equation 1). We would thus, by decreasing the load factor L, get the plane S T', or by decreasing the kw.-hr. charge z alone, S' T would result, or we reduce both L and z, and get S" T"; an increase of f finally with constant z and constant L would result in S T''', etc.

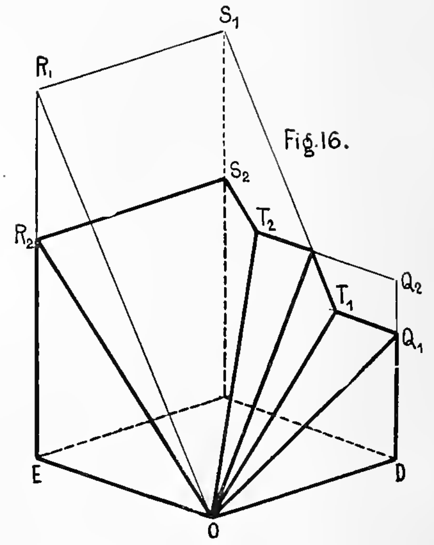
Minimum bills are represented by horizontal planes; for instance, the rate Fig. 8 b with the additional feature of a minimum bill of $1.00 per month would change into Fig. 12. In the range of the minimum bill we have again a special case of the three-charge rate system, that is with both y and z = O.











A minimum bill proportional to the demand (for instance, a minimum of $3.00 per kw. of demand) is given by a plane passing through the origin O and the axis of energy consumption O E, that is, plane O R S in Fig. 13. It means a three-charge system with $x = z = O$; that is a flat demand rate in the range of that minimum. By comparing Figs. 13 and 5, we see at once the difference between a minimum charge per kw. on the one hand, and a charge per kw. on top of which the other charges are made. Fig. 14 represents a model of a multiple rate with a primary charge of 9c per kw.-hr. for the first 6 per cent load factor; 7c for the next 6 per cent, and 4c for the balance. This rate, therefore, is, as it were, an extended Wright rate, with a primary, secondary and tertiary charge. The minimum bill is $1 per kw. per month.

If we intersect the rate model with a vertical plane parallel to the axis of energy consumption; for instance, with D Q R S T in Fig. 13, we get a curve R S T, giving the ordinates of the bills of all customers who have a maximum demand = O D, as function of their energy consumption, and since in this curve we have a fixed maximum demand, the energy consumption is proportional to the load factor, and the distance measured in the direction D Q therefore will also represent load factors. For the same reason, we can also take the ordinates (with a change of scale) as revenue from the customer per kw. maximum demand (or kw. connected load, etc., as the case may be). The solid model, therefore, also directly shows the income from the customer per kw. of demand plotted against load factors. Since the central station's capacity can be assumed to be roughly proportional to the capital invested, the income per kw. has a more immediate bearing on the interest of the capital invested (especially in water power plants with high demand and low operating expenses) than the ordinarily chosen figure of cents per kw.-hr.

Other Methods of Rate Representation.

This last named way of representing a rate graphically by using the average price per kw.-hr. as vertical ordinate is used by all other methods of graphical rate representation. The most widely used method of

graphical representation is a two dimensional one by plotting a curve showing the average price per kw.-hr. against the load factor for a certain definite maximum demand, and preparing such curve sheets for a number of definite figures of the maximum demand. By setting these curve sheets (one for each maximum demand) one behind the other in space so that their planes parallel, and at the proper distance, we obtain a solid body to represent the rate, with the three axes representing kw.-hrs., load factor and average cents per kw.-hr.; (see, for instance, "Electrical World," November 4, 1911, page 1141, "Wholesale Rates for Electric Service at Cincinnati").

If we consider, however, the fundamental law of expenses of a central station as described above, the total cost of serving a customer is composed of, first, one part caused by the demand only and proportional thereto; second, of another amount caused by the energy consumption and proportional thereto; and third, of a constant amount, and we see that the fundamental primitive determining variables are dollars (or cents), kilowatts and kilowatt-hours; average price per kw.-hr. (cents per kw.-hr.) and load factor (kw.-hrs. per kw.) are only secondary factors derived from the primary ones by division:

$$\frac{\text{Total bill}}{\text{kw.-hrs.}} \text{ and } \frac{\text{kw.-hrs.}}{\text{kw.}}.$$ The relations between these "primary" factors—a, d and e—are equations of the first degree in case of the three-charge system and its special cases. That means the rate is represented by planes (or straight lines in two-dimensional representation); rates represented by curved surfaces are very rare exceptions.

On the other hand, with the older systems (average price per kw.-hr. and load factor) we get complicated curved surfaces of the second order, hyperbolic paraboloids, etc. (and even surfaces of the third order) for the simple three-charge system.[1] In case of a two-dimensional representation the resulting curves are mostly hyperbolas. (Only in case of the straight kw.-hr. rate, which hardly needs any geometrical representation at all, we get planes or straight lines respectively.)

The tangents of the angles of inclination of the planes towards the d and e axes immediately show the price of each additional kw. and kw.-hr.; in other words, the kw. and kw.-hr. charges, whereas with the other method (cents per kw.-hr. as ordinate) we get curved lines which do not indicate anything at all to the eye about the nature of the rate. If, for instance, in the multiple rate which is represented by both Figs. 14 a and 14 b, we change the price per additional kw.-hr., that is, the kw.-hr. charge (not to be confused with the average price per kw.-hr.) in the tertiary range the straight line tu will change into tu', which immediately by its direction indicates the nature of the change, whereas, the corresponding new curve in Fig. 14 b (apart from its much more complicated way of construction(does not say very much to the eye, except that the rates are now lower, and it does not show the new law of the rates.

[1]The same is true for a system of co-ordinates of demand, energy consumption and average price per kw.-hr., which system has been introduced by the author in his serial article "Some Geometrical Aspects of the Three Charge Rate System" (Electrical Review and Western Elec., February 11th, 18th and 25th, 1911, Figs. 7 and 8a-8m).

If the rates are represented by the "total bill — kw.-kw.hr." co-ordinates, the derived functions of load factor and average cost per kw.-hr. can be easily found, if desired, as tangents of angles between straight lines or planes as shown above—relations which are so simple that in many cases for comparing values we need not even draw the lines actually, but imagining their position on the paper or in space gives us the information wanted. Conversely, however, if we want to know how large the total bills are under the "average price-load factor-kw.-hr." system, we no more have such simple graphic relations for the transformation.

If we compare one rate to another in its effect to a certain customer, we compare what his bills would be under both rates, and also from this point of view the system of choosing the total bills as ordinates seems to be more direct than the other one.

Rates With More Than Three Variables.

Even in those rare cases when the rate schedule contains a fourth variable—which usually is a guarantee on the part of the customer—one can represent the rate by a three-dimensioned model under certain assumptions. Take, for instance, the business lighting rates in use in one of the large cities on the coast; the customer gets a rate of

8c per kw.-hr., subject to an annual guarantee of \$40.20 per kw.
7c per kw.-hr., subject to an annual guarantee of 44.40 per kw.
6c per kw.-hr., subject to an annual guarantee of 48.00 per kw.
.... etc. ....

The annual guarantee of \$40.20 per kw. is represented by a plane of the type Fig. 4, that is O E P_1 Q_1 in Fig. 15a, where tan r_1 equals \$40.20 per kw. per annum. The 8c per kw.-hr. rate, on the other hand, is represented by O D R_1 S_1, tan s_1 equals 8c per kw.-hr. The customer is charged according to plane O D R_1 S_1, provided he does not get below O E P_1 Q_1. Therefore, of each plane, only the heavy outlined parts must be used (O R_1 S_1 T_1 Q_1). If the customer, however, guarantees \$44.40 instead of \$40.20, we get plane O E P_2 Q_2, Fig. 15b, at a steeper inclination r_2 than O E P_1 Q_1).[1] (tan r_2 = \$44.40 per kw.-hr. per annum) and O D R_2 S_2 at a smaller angle s_2 corresponding to 7c per kw.-hr. If we now assume that each customer chooses his guarantee correctly, that is so that he gets the smallest bill possible under the rates, we have to combine the two heavy outlined surfaces in Figs. 15a and 15b into a single one in such a way that for every point on the bottom plane we select the surface with the smaller vertical ordinate, and thus arrive at Fig. 16.

By applying the same method for all steps of the yearly guarantees of the schedule, we finally get the model in Fig. 17, which also shows the additional feature of a discount which is given only if the bill is larger than \$100 per month.

Tar as a Fuel for the Diesel Engine.

Tar oil has become a more or less common fuel for Diesel engines of 600 or 800 h.p. rating and it is understood that tar is used in at least one engine of 4000 h.p. rating. Recent experiments indicate that both thin gas-retort tar and thick oven tar can be used by injecting into the cylinder a small percentage of light oil to assist in igniting the tar.

[1]The relations between the drawings 15a and 15b, are on purpose exaggerated, and not to scale.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Western Manufacturing Opportunity

For sixty years the West has been a producer of raw materials and a consumer of manufactured products. In its zeal to export its natural wealth it has failed to exploit its manufacturing advantages. Few of the manufacturies which have been established to supply local needs have been managed with that business acumen which has enabled Eastern manufacturers' agents to control the tremendous buying power of Western communities. The reasons for this neglect were good and sufficient in their day. But that day is passing.

Nature has been equally as bountiful in supplying manufacturing facilities as in furnishing raw materials. With splendid natural harbors at Puget Sound, the Columbia River, San Francisco Bay and San Diego and the excellent artificial ports at Los Angeles and other localities, the ships of all nations can find ample anchorage and provide cheap transportation to and from the markets of the world.

The first half century of Western development was accomplished without the aid of cheap fuel. This lack applied the needed spur that forced the utilization of its protean water power and now, with the development of its latent oil resources, the combination of oil fuel and water power enables the West to compete in the manufacturing field in every essential factor excepting cheap labor. The latter will be a concomitant of the early opening of the Panama Canal, which will bring the skilled workmen of other countries to a land where climatic conditions allow them to work comfortably every day in the year, surrounded by conveniences and liberties not to be found at home. This will give to the Pacific Coast the same commanding position that the Atlantic seaboard has enjoyed for many years in receiving direct immigration.

Comparison shows that the manufacturing rank of the various states closely approximates to their relative population. The Pacific Coast states have borne out this ratio in the past and it is fair to assume that the present rapid increase in population will coincide with an equally rapid increase in the value of manufactured products.

Although agriculture and mining are likely to long continue as the principal industries of the West and lumbering and the preparation of food products the most important manufacturing interests, other concerns are rapidly taking root,—cement plants, foundry and machine shops and oil refineries. Along the line of electrical manufacturing, Southern California is the home of one of the largest makers of electric heating appliances as well as the site of a growing motor works. On San Francisco Bay there is a large cable manufacturing plant, an important lamp making industry and several switchboard manufacturers. A porcelain plant is just being established to turn out electric fittings, a calcium carbide works is nearing completion and a new carbon company is nearly

ready to market its wares. The Northwest is still chiefly concerned with lumbering although a manufacturer of electrical fittings is meeting with success.

Central stations would find it greatly to their interests to co-operate with the chamber of commerce, or other commercial organizations of the various towns they serve, in advertising the resources of the region, not only on account of the cheap power they can supply to off-peak consumers but also on account of the natural products which can be converted into manufactured articles.

It will not be many years before the intensified cultivation of Western farms will require artificial fertilization whose constituents of phosphorus, potassium and nitrogen can best be won by the aid of electricity. Many other equally valuable industries, particularly in the manufacture of such human necessities as clothing and food products, as well as the refining of metals, can be more economically conducted in the West and thence cheaply carried to the markets of the world.

Electric Railway Franchises

The vexing question of new franchises for electric railway extensions into outlying districts has been engaging the attention of the municipal authorities at Seattle and Portland for some months past. In several instances the street railway officials and those of the cities have practically come to a dead-lock and no relief is in sight until the city charter is amended or a new one adopted and the provisions put into effect. The property owners demand that service be extended into thinly populated territories, while the municipalities either place such exorbitant valuations or exact such unreasonable terms that the railway companies refuse to do the new work on the ground that it cannot be financed.

A city's future prosperity is dependent upon adequate transit facilities, for which it must rely on private enterprise. But capital will not respond unless a merchantable franchise is offered. The street railway business is one which constantly calls for new money and under the present limited returns on investment, it is yearly becoming more and more difficult to interest investors.

It is the engineer who blazes the way and digs the ditch for capital to enter a new territory. Capital is a fluid body which follows the path of least resistance. Dam it with restrictive legislation and it is diverted to more lucrative fields. Recent laws in many states promise to hamper profitable investment, particularly in public utility projects, and at once a marked exodus of path-finding engineers is noted to new fields. The projects they investigate will appeal more strongly to the men of money than do those at home and as a consequence capital will not be available to carry out local requirements.

Public-favor-currying politicians propose that fares be arbitrarily reduced from five to three cents in the face of the fact that the cost of almost every class of material entering into electric railway construction has recently advanced to such a point that a six-cent fare would be more logical. The politician's first idea of statesmanship is that "the government exists to pay salaries and the more salaries the better," and so he is continually advocating municipal ownership, the municipality being given the right to acquire the investors' property at any time it may see fit without any valuation being placed on the franchises. Under such conditions the public should not blame the company for refusing to make extensions of doubtful earning ability.

The extremes to which such exactions may proceed is exemplified by the recent drastic ordinance of the Chicago city council that prohibits a traction company from displaying advertising matter either in its cars or at its stations because such privilege is not definitely assigned in the provisions of the franchise. How much wiser would it be merely to amend that instrument!

At Seattle a committee has been appointed from the franchise committee of the city council and the various commercial and municipal clubs to assist in drafting an amendment to the present city charter on the subject of street railway extensions. Until this action is completed little relief is to be expected.

At Portland the franchise matter first came up last fall when the electric company requested a blanket grant for many lines which it was not anxious to build on account of the large expenditure involved, but was willing to concede to the demand of the property owners. After several months of futile effort to decide the terms of the proposed grant, the street committee recommended to the council that the franchise be granted, but since that time so many obstructions have been interposed that the company cannot see its way clear to accept the proposed terms. The extensions are mostly stub-ends of the general franchise and are loaded up with restrictions and regulations that are not included in the main franchise which has yet many years to run.

The ultimate solution of these questions appears to rest with the complete surrender of municipal control of public utilities to a state commission. Washington and California already have such bodies, while Oregon will probably adopt a similar policy this year. State control should be independent of franchises heretofore or hereafter granted by cities and be based upon uniform rulings. In order that the cities and their citizens may gain the advantages to be derived from increased transportation facilities would it not be the course of wisdom to remove the obnoxious restrictions at once and depend upon future commission decisions to regulate rates and taxes for revenue? These are questions which should be settled upon a fair and just basis by men of experience, responsibility and fairness.

PERSONALS.

C. L. Cory has returned to San Francisco after an outing in the Yosemite Valley.

J. V. Kunze, manager of the Atlantic department of the Pelton Water Wheel Company, is on his way to San Francisco.

R. A. Bowden has been appointed sales manager for the San Francisco division of the Great Western Power Company.

Thomas Mirk, of Hunt, Mirk & Company, has returned to San Francisco from Tahoe Tavern, where he made a short stay.

George E. Bunker, president of the Ontario Light & Power Company, is a recent arrival at San Francisco from Uplands, Cal.

Addison Day, assistant secretary of the Los Angeles Gas & Electric Company, has been spending a vacation at Lake Tahoe.

H. V. Carter, president of the Pacific States Electric Company, visited Los Angeles during the past week, stopping over at San Jose on the return trip.

A. W. Bullard, vice-president and general manager of the Great Western Power Company, returned to San Francisco during the week from a southern trip.

Thornwell Mullally, the assistant to the president of the United Railroads, has returned from an Eastern trip in connection with the purchasing of additional electric cars.

Wynn Meredith has just returned to San Francisco after visiting British Columbia in connection with the work which Sanderson & Porter are supervising on the Victoria water supply.

A. E. Barlow, general sales manager on the Pacific Coast for the American Ever Ready Company will leave Seattle about August 1 and thereafter make his headquarters at San Francisco.

Fred L. Webster of the Allis-Chalmers Company has returned to San Francisco after visiting Los Angeles on business. **E. A. Quinn**, of the electrical sales department of the company, is visiting Seattle.

Frank Fowden, manager of the Brooks-Follis Company, visited Portland during the past week. After attending the Electrical Contractors' Association convention at San Jose, he will make a trip to Salt Lake City.

E. E. Carpenter, formerly resident engineer in charge of the hydroelectric development of the Jordan River for the British Columbia Electric Railway Company, has been appointed civil engineer for the Panama-Pacific Exposition.

S. K. Colby, vice-president of Pierson, Roeding & Co., and **Joseph Hanna**, representing the Niles Car Company of Niles, Ohio, are at Portland in connection with opening bids for the Oregon Electric Railway's new cars.

J. A. McMonies has been appointed manager of the electric appliance department of the Great Western Power Company. An extensive display room is being fitted up on the ground floor of the general office building at 233 Post street.

W. S. Hanbridge, secretary of the State Electrical Contractors' Association, returned to San Francisco during the week, after attending the annual convention of the National Electrical Contractors' Association at Denver, July 17th to 19th.

M. R. Starring, president of the United Railways Investment Company, and **J. H. Reed**, president of the Railway Companies of Pittsburg, are at San Francisco in consultation with **Patrick Calhoun**, president of the United Railroads, and **G. W. Bacon**, president of the Sierra & San Francisco Power Company.

Heinrich Homberger has returned to San Francisco after visiting Los Angeles on some expert work. He recently conducted tests at the Borel power station of the Pacific Light & Power Corporation. The 4000-h.p. turbines manufactured by the Pelton Water Wheel Company were found to give complete satisfaction.

Ralph Clapp and **C. D. Lamoree**, salesmen connected with the Westinghouse Electric & Manufacturing Company's Los Angeles office visited San Francisco office of the company before attending the annual convention of the State Electrical Contractors' Association at San Jose.

J. D. Beebe has resigned his position as manager of the office of the Pacific Power & Light Company at Prosser, Washington, to become construction engineer with the Arizona Copper Company, at Clifton, Arizona. His place at Prosser has been taken by **W. E. Gay**, of North Yakima.

H. W. Crozier has been elected chairman of the executive committee of the San Francisco Section of the American Institute of Electrical Engineers and **A. G. Jones**, secretary. **P. T. Hanscom** is chairman of the papers' committee, **C. L. Cory** of the membership committee and **A. H. Halloran** of the entertainment committee.

J. L. Crider has resigned as chief engineer of the New York, Westchester & Boston Railroad to become superintendent in charge of the new construction work on the Oakland, Antioch & Eastern Railway and will also act in a consulting capacity on the Oakland & Antioch, which is approaching completion.

Robert Strahorn has been made vice-president and general manager of the Portland, Eugene & Eastern Railway, which is the name under which the Southern Pacific Company is electrifying 200 miles of existing steam roads in Oregon and constructing 100 miles of electric road. Offices have been opened in the Wells Fargo Building, Portland.

J. H. Wise, assistant general manager of the Pacific Gas & Electric Company, and **Fred S. Myrtle**, head of the publicity department, inspected the work in progress on the hill and at the Lake Spaulding dam during the week. An army of men is at work on the hydroelectric development which will require about two years, for its final completion.

Julian Woodridge, of Ford, Bacon, Davis, returned to San Francisco during the week after an inspection of the extension of the transmission lines of the Sierra & San Francisco Power Company's line from Alviso to Salinas, eighty miles, and the Coast Valleys Gas & Electric Company's line from Salinas to King City, a distance of fifty miles, making the total distance covered 130 miles. **H. F. Jackson**, general manager of the two companies, also visited the scene of operations recently.

A. E. Barlow, general sales manager of the American Ever Ready Company on the Pacific Coast, under President R. F. Oakes, after having had his headquarters at Seattle for a number of months, will arrive at San Francisco, August 1, and will thereafter be located at Factory No. 8. R. F. Oakes contemplates motoring with a party to Lake Tahoe and spending the month of August in that vicinity. Business in dry batteries is very active with the Ever Ready company, and night work is necessary at the San Francisco plant. The flash-light season will soon open.

TRADE NOTES.

Hunt, Mirk & Company will proceed with the installing of a low-pressure steam distribution system for the United Light, Heat & Fuel Company at San Diego. Steam will be obtained from the power plant of the San Diego Electric Railway Company.

The Pelton Water Wheel Company have made the initial shipment of portions of the three Pelton-Doble tangential water wheels for the hydroelectric plant that is being installed in connection with the Los Angeles aqueduct project. Each generating unit is to be of 10,000 kw.

A contract was recently awarded by the United Railroads of San Francisco to the J. G. Brill Company, represented on the Pacific Coast by Pierson, Roeding & Co., for 65 P. A. Y. E., California type, cars, including Brill trucks. The cars will be similar to the new "700" type now in operation on the Mission and Fillmore line. The steps will be lowered for the convenience of passengers.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

DENVER CONVENTION OF NATIONAL ASSOCIATION.

The twelfth annual convention of the National Electrical Contractors' Association was held at Denver, July 17-19, 1912. The directors and executive committee met in joint sessions at 10 a. m. on the morning of July 16 with President M. L. Barnes in the chair. A great deal of important business was transacted, including the reports of committees. Directors were present from thirteen states, Illinois and New York each having three, California two, and the balance one.

At 10:30 a. m. Wednesday, July 17, President Barnes called the meeting to order in open session. The speakers were W. P. Carstarphen, M. L. Barnes, Gov. John F. Shafroth, Mayor Henry J. Arnold, Mr. Maurice B. Bisco and Mr. Alva F. Traver. In the afternoon a business meeting was held and during a recess Mr. Philip S. Dodd spoke on "Co-operation." The ladies were given a sightseeing trip around Denver in auto-buses. In the evening a Sons of Jove Rejuvenation was held and a class of twenty-one were introduced into the mystery of Jovianism. At 9 p. m. a reception and a dance were given and a very pleasant evening spent. The California delegates distributed one thousand 1915 badges and California poppies and it is needless to say that everyone wore California colors.

Thursday was devoted to closed sessions. A committee from the Jobbers' Association was present and presented a paper, a copy of which follows this account.

Thursday noon the members of the association and their ladies were the guests of the Denver Electrical Club, about 500 people sitting down to luncheon.

Thursday night the annual dinner was given with an attendance of 250. A roll call of the charter members was held by E. V. McCleary and only nine of the original fifty responded. Mr. McCleary then spoke of the good work done by President Barnes and presented him with a silver service in behalf of the members throughout the United States. The retiring president was very much affected and spoke a few words of thanks. A vaudeville entertainment was given, and while Jas. Strong is no mean artist, still Jas. Wilton shows he can look out for the welfare of all.

Friday's trip to Corona over the Moffatt Road was a success and one that will never be forgotten by the members of the N. E. C. A. Luncheon was served on the train and it was one continual gasp of appreciation as the beautiful panorama was unwound as the train moved along toward Corona. A fine time was had snowballing. Photos were taken at Corona on a snow bank and also at Yankee Doodle Lake. The crowd reached Denver happy and tired to take their train for home.

The officers elected to serve during the ensuing term are: E. Freeman, president; H. S. Potter, first vice-president; J. C. Hartzel, second vice-president; W. Martin, secretary; W. L. Hutchinson, treasurer; J. C. Stearns, sergeant-at-arms.

To the California members who are making their first trip to a National convention, the proceedings were very interesting, and they were very strongly convinced of the necessity of supporting the National in the good work they were doing.

ELECTRICAL CONTRACTORS' ASSOCIATION NOTES.

The Butte Electric Company was the lowest bidder on the signal system for the County Hospital, their bid being $12,900. Other bids went as high as $14,400.

The Decker Electrical Construction Company was awarded the electric work for a new hotel building being erected for James Phelan on Market street near Seventh.

RELATIONS BETWEEN ELECTRICAL CONTRACTORS AND JOBBER.[1]

BY W. S. BISSELL.

In the electrical field a condition exists, not true of all businesses, in that the term "contractor" is also a synonym in most instances for "electrical dealer or retailer." I preface my remarks by assuming that your program committee wish me to bear this distinction in mind.

It is a little embarrassing to talk to the subject of the Relations between the Contractor and the Jobber, for it would seem that the interests of both are so intertwined and identical as to permit of but little discussion. Surely the jobber is vitally interested in the success of the contractor, and therefore a condition is created that marks a step on his part towards the closest and most friendly relationship.

The jobber is also prone to believe that this friendly feeling is generally reciprocated by the contractors as a whole, and speaking for the Association we represent, our committee carries to you a message, not only of the pleasure at the opportunity of meeting with you, but a true appreciation of the courtesy and kindly feeling evidenced by your invitation.

What is the relationship that does or should exist between the contractor and the jobber? There is no alliance in the strict interpretation of the word nor can there be, as I understand it, between the two Associations.

But, in the very nature of things, there can and does exist a co-operative relationship, and these two words sum up the situation.

The jobber stands today committed to your own resolution that the natural course of merchandise is from manufacturer to jobber, then to the contractor, central station, etc., and then to the consumer. Surely it is only through co-operative measures that this channel may eventually be marked so well that no manufacturer, jobber or contractor will care to deviate from its course.

The jobbers' desire and willingness to co-operate with the contractor and other allied interests is also evidenced by their resolution authorizing the purchase of a supply of wiring handbooks, to be distributed pro rata among the jobbers so that they, too, might be identified in helping with good work.

True, this co-operative tie that binds your business and ours has not as yet been pulled taut, and the distance between the jobber and large contractor is still great. But the trend is in the right direction, and while ideal conditions may never be possible, we can and should be closer together than we are now.

Just how or when this will be brought about I cannot tell you, but that it will come as the natural economic answer I am firmly convinced.

Both contractor and jobber working together can, however, "speed the day," and as such action is more desirable, let us cast around for the obstacles now lying in our path.

Looming up like a lighthouse is the trite cry of "eliminate the middleman." This may not be a popular clamor today. We doubt it. For while acknowledging some noise instigated by certain papers and magazines, it seems impossible that the people, who are always right, after careful consideration can help but see the fallacy of the argument. If successful, it would simply increase the cost of distribution and retard matters by just that much additional expense, which in the end the public must pay.

Taking up the subject from the standpoint of the jobber and the contractor, we acknowledge that there are those

[1]Paper presented at 12th Annual Convention, National Electrical Contractors' Association, Denver, July 18, 1912.

among your organization who disagree, but these we feel are individual companies who cut their cloth by conditions that may exist in their particular localities.

Looking at the matter broadly, surely the concentration of merchandise drawn from north, east, south and west, the shipping facilities, and the ability to make small or large assorted shipments, and many of them are, and always will be, potent reasons why the contractor will always need and use the jobber as his source of supply.

To carry the argument further, is not the contractor relieved of an excessive merchandise investment with the consequent opportunity to devote part of his funds elsewhere to better advantage, and if of limited resources can he not and does he not turn to his jobber for financial assistance?

A lawyer will tell you that no man should plead his own case, and rather than jeopardize the interest of the jobber, I quote here a letter from a manufacturer that has been brought to my attention:

"It has been our experience, and it is our settled conviction, that the user can do very much better to purchase from the jobber than he can from the manufacturer. This may at first seem strange to him, but nevertheless, it is a fact, which experience will demonstrate, we believe, in every case.

"The manufacturer is usually at a long distance from the user; he is manufacturing only one line of material, and he cannot by any possibility afford to study the requirements of the user by sending his traveling man to them and by cataloging the things they require, which is possible on the part of the jobber, only through the fact that he handles the entire line of the user, so that the expense of maintaining a stock adjacent to the user, of issuing catalogs and price sheets for his information and assistance in buying, and of sending traveling men frequently to discuss with him his needs, is only possible because the jobber is able to spread expense of all this procedure over the entire line of material which the user requires, and thus the percentage on each individual item is very small, where it would be very large in the case of the manufacturer. The jobber's profit, from our understanding of the matter, is made out of the user whose requirements are small at any one time. Such requirements the manufacturer could not take care of at all, as they would be too much trouble for him to consider doing so at any price. When it comes to the large user, however, and especially to the user who buys in carloads, and where shipment is made direct from the factory, the jobber takes care of such business on a margin which the manufacturer could not begin to do at any profit whatever. For instance, on a carload of material, such as you require, the jobber's profit is actually about 3 per cent, and for this he sends out his catalog to you; gets you the prices; studies your requirements; acts, in a sense, as an arbitrator between you and the factory if any difference of opinion arises; carries the account, as a manufacturer at a long distance would not want to do and, on the whole, gives you at least double the value of the difference in price that you have to pay over what the jobber would pay. On the other hand, any manufacturer who would sell you at all would charge you for equal quality material at least as much as your local jobber would charge you, and under these conditions we believe that it is the duty of the user to support the jobber in his vicinity, building him up in this way, so that he will be in position to supply the users' emergency requirements which no factory could take care of, and which the user would be in very bad shape, for if it were not possible for the jobber to supply him quickly."

If for nothing else do not these reasons alone make our mutual success much to be desired and draw us both, contractor and jobber, together in closer relationship?

In just such a relationship lies the strength of the situation as a force is created that is practically irresistible; while failure to work together only helps to make conditions worse. We are both facing toward the common goal—improved relations with the manufacturers. The situation now is bad for both, more so for the contractor than for the jobber, but how are we going to better it if our forces are divided? Why not march together, side by side?

Another obstacle is the jobber who is a contractor, and another, the contractor posing as a jobber. This is a condition that can be handled locally and will be eventually straightened out through co-operative measures, promoted by the Sons of Jove, luncheon clubs, etc. But both are thorns in the flesh, and as they loom large on the broad field as the manufacturer sees it should be considered here.

These deterrent elements deserve no encouragement from either of their associations. Yet each man points to the other as the influence that affects his policy; each claims the necessity of fighting fire with fire. As a result, neither develops his respective field to its full possibilities and are both immeasurably handicapped by divided interests.

If this last were not true there is no reason why the whole electrical field could not be controlled by one or two companies. In view of recent developments it may be that we are tending that way. It is something to think about.

If the danger signal is there isn't it time for a closer reciprocal relation and a well established understanding as regards the dividing line between the jobber and contractor?

It certainly is not the time for the contractor to withhold patronage from the jobber. The jobber, too, must live, and the disappearing roles have not as yet been definitely assigned.

Are prevailing "quantity prices" another obstacle? They may or may not be. There is a chance for argument. We believe they stand for good. One thing is certain. They are fixed. They are essential. Quantity always has made the price and always will. It protects the big buyer and still is fair to the smaller brother who, buying from hand to mouth, deserves his chance to prove his ability and forge ahead, if he can, from curbstone operation to the larger organization with its increased expenses and responsibilities. The trouble lies not so much in the "quantity price" or "sliding scale" itself as it does in the dissatisfaction it creates, its abuse and in attempts on the part of some to break down through demanding the large lot price and buying in smaller quantity. The contractor alone has not been guilty in this respect, yet if we each could see the futility and inadvisability of such effort and individually decide to give our own support to those who offered this protection the situation would be simplified.

Dissatisfaction exists in the knowledge of a differential in which possibly you or I are not participating. What difference does it make, provided we are on an even footing in our class?

The contractor deserves and is provided with a margin on his purchases and should not the same rule hold good for the jobber, too? We think so, but seldom do we hear such argument advanced from the contractor's side of the fence.

The abuse of "quantity prices" lies in the fact that some of us are our own worst enemies. That some take advantage of the differential, but instead of placing the money in their own pockets where it belongs, foolishly or ignorantly give it away in cut prices. This is particularly true of the contractor, who, mistaking the jobbers' pasture as the "Elysian fields," thinks that he enters them through selling below the prevailing manufacturers' re-sale and in that way antagonizes others and loses money for himself. None of which spells harmony or leads towards co-operation.

The answer is to be found in education. At least some have found it so. Teach or influence every man to figure his actual costs and know. It is just this failure to figure cost of operation that results, be he jobber or contractor, in a selling price below the real cost of doing business.

There is nothing more illuminating than the discovery that a big percentage of one's operating charges are placed against business averaging but little in the aggregate. Discoveries like this are the kind that lead to quick revision of one's re-sale of percentage of profit figured.

As business men, you would consider it suicidal to open a new bank account every day and poor policy to have three or four bank accounts in the same town. The contractor's position with the jobber is in many instances the same as that of any business depositor with his bank. For obvious reasons this condition seldom if ever exists between the

contractor and the manufacturer. If the analogy holds good is it not in order for the jobber to point out here that a good account in one bank brings the accommodations that could not be secured under other conditions. Yet it is this very situation that presents an obstacle that the jobber, and I believe your association, are among the first to deprecate because an unnatural, untenable, and needless business policy that the contractor should not countenance nor the jobber have to offer. And while admitting that such subsidizing is wrong, has it not in many instances been developed through the failure to co-operate on the part of the influential contractor, who in that way forces the jobber to develop a market of his own that may or may not be of a caliber that will prevent the first class contractor from making any money on about 90 per cent of his jobs.

Another obstacle that blocks the way to the contractor's success and for that reason has a bearing in this paper, is the competition from the central stations, due not so much to their distributing, but to the giving away of current-consuming articles or the selling below cost. Happily, conditions are rapidly being bettered in comparison to what they were throughout the country.

We think that more and more as the lighting companies grow familiar with merchandising, as distinguished from engineering, that they will realize that the way to sell lots of current and make money out of it is to stick to the current, and if necessary reduce the price of "juice," which, after all, is the best, quickest and most prominent way to "popularize electricity."

Besides that a saving in expense will be effected by not trying to run a selling department which can be better taken care of by those entirely outside and separate from the lighting organization.

But even where the lighting people insist on maintaining this department let them sell at a profit and their success will be great, like that of a company recently reported in the trade papers, which in changing from a policy of selling at cost, to that of a profit, not only increased the number of appliances and kw. sold but made a profit in place of a loss that before had averaged $6 per kw. in securing appliance business.

These same conditions hold true as regards lamps. While it may have been necessary at one time, surely large central stations are today no more required to distribute lamps than they are heaters, and certainly no reason for their sale below cost, or on the free renewal basis. Such a policy cannot qualify as co-operative in a field where it means so much to all concerned.

Still you all know the arguments the central stations have advanced that co-operation did not come from the contractor, that retail stores were not operated, that new ideas were not taken up nor aggressive salesmanship developed; that prices much too high were asked and that of necessity they were forced to adopt the methods used.

This may have been correct at one time, but is it true today? We think not. Certainly it behooves the contractor to conduct a retail store. Not only because the department store, hardware store, gas mantel store, and others are right now flirting with this trade, but because it is his bread and butter to keep in touch with the consuming public, let alone the fact that it is absolutely essential that he be in position to prove to the central station man that he has in the contractors a combined force of solicitors that can accomplish wonders if he will only use them.

Incidentally the central station which eliminates the contractor is in the same category as the manufacturer who goes direct to the consumer or contractor and, like all things else, will stop only when the situation is changed and conditions prove such action is no longer necessary.

That there is an evolution coming in the central station business no one doubts. In fact, it has already been claimed by good authority that in five or ten years the heating load will exceed the lighting load, and this with ventilation, and refrigeration, opens up a field of current-consuming devices of which the contractor who retails must, if consistent, and a good business man, as well, surely take advantage.

That he will do this is evidenced by the increased interest shown everywhere in store counter trade, the electric shops, the improved personnel of the selling organization, the better window displays and the higher grade and more judicious advertising.

Possibly it is through this development and co-operative effort lying before us that we may all, manufacturer, central station jobber, contractor and dealer, find our way out to the promised land, where the cloud called "lack of confidence" which seems to affect us all, will not exist.

Education, a better knowledge of merchandising methods, more stability from a credit standpoint secured by restriction of business to each man's financial capacity and the application of real business ability will all make for this solution.

Whether this be far off or near we do not know. But surely co-operation will carry us farther and whether the Moses to show us the way to better things be in your organization, or ours, the jobber is in a receptive mood and will follow any feasible step in the right direction.

To return to our own more intimate difficulties this is the thought I would leave with you. A manufacturer cannot be a jobber, a jobber a contractor, nor a contractor a jobber without assuming all the risks and responsibilities that accompany each business, and when he does the exclusive jobber or exclusive contractor has him hopelessly handicapped.

When the time comes for either the jobber or the contractor to be eliminated it will come when either one or the other has ceased to be useful. That time has not arrived.

FURTHER IMPROVEMENTS IN HOLOPHANE.

A new standard line of high efficiency reflectors will be offered shortly by the Nelite Works of General Electric Company. The new line will be known under the trade name of "Xtraficiency" and will not only be of considerably greater efficiency than present standard line Holophane reflectors, but will actually be the most efficient lighting glassware in the world. Electrical Testing Laboratories, photometric tests will be offered to substantiate this statement. In announcing the new line, Mr. W. F. Minor, in charge of the efficiency glassware sales of the Nelite Works, said:

"Now that we are in position to sell every type of illuminating glassware, we realize the distinct position of each type. At one time, the industry undoubtedly lost its head over Holophane—that is to say, the efficiency and ease of installation of our product was such that Holophane glass was frequently used in places where another type of glassware might have served to better advantage. The natural result of this over-enthusiasm for high efficiency glass led in time to an equally erroneous prejudice in favor of opal glass, so that today we see many installations equipped with our own opal or others which might better have been equipped with Holophane.

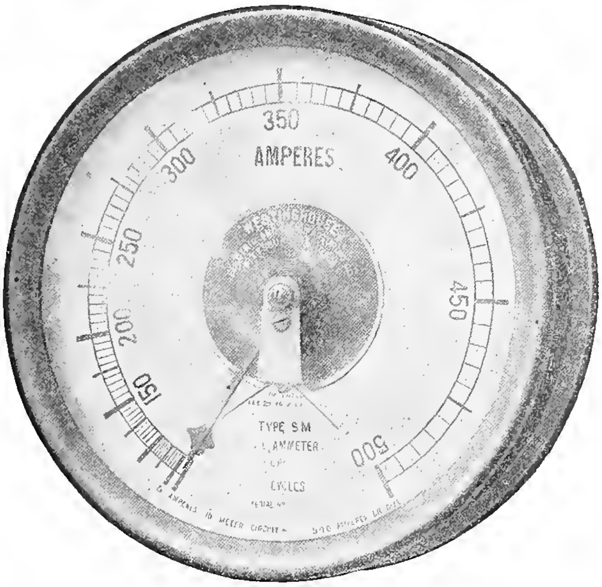
The new "Xtraficiency" line of Holophane glassware will help to define the proper place for each class of equipment. Where efficiency is the chief consideration, Holophane is without doubt the proper equipment. As decorative necessity or architectural restrictions call for more decorative glassware, the opals find a natural place. I think that in future we will not see prejudice in favor of any particular type of lighting equipment carried to the lengths it has been carried in the past, and that the glassware selected for each installation will be selected with a view to the exact requirements of the case and not in accordance with the ready-made arguments of the man making the installation."

INDUSTRIAL

INDUCTION TYPE SWITCHBOARD METERS.

Modern switchboard practice demands certain characteristics in indicating meters, without which they are unsatisfactory. These characteristics are: compactness, to enable a large number of meters to be mounted in minimum space; readability, to make possible the reading of a large number of meters from one point which necessitates also heavy damping; ruggedness, to prevent overloads and other abnormal conditions from throwing the meters out of calibration; and simplicity, so that repairs can be made quickly and without sending the meters back to the factory.

All these desirable characteristics are features of meters operating on the induction principle if properly designed.



Westinghouse 7-inch A.C. Ammeter.

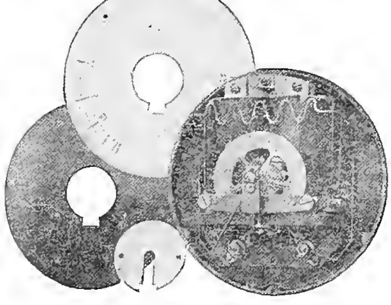
The induction meters recently introduced by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., have scales covering 300 degrees, thus securing 14½ in. scales even in meters only seven inches in diameter. The damping is such that the pointer does not pulsate or overswing the mark even with a change in load equivalent to full scale of the meter. All parts are very simple and rugged as can be seen from the accompanying illustrations. No moving coils or flexible connections are required.

The movement used in the ammeters consists of an electro-magnetic structure so designed as to produce a rotating field in an annular air-gap, and a pivoted light metal drum in this air-gap. The arrangement of electrical and magnetic circuits is such that a high torque is produced by induction in the pivoted drum, proportional to the square of the current in the primary winding of the meter (connected in series with the current transformer or the line), independent of temperature, wave form, or frequency within wide limits. This torque is opposed by the restraining force of a comparatively heavy spiral spring, so that the deflection is proportional to the square of the current. The scale is clearly legible from ten per cent to full scale.

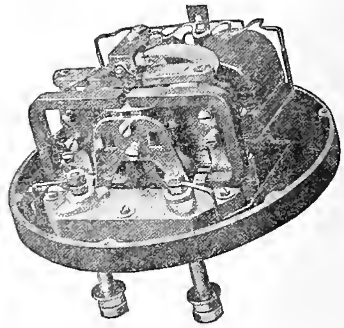
Voltmeters use the same type of movement as the ammeters, but the primary winding of the meter is connected across the line, in series with a high resistance contained in the meter case.

By means of an aluminum disk mounted on the shaft and moving between the poles of two powerful permanent magnets, intense damping is obtained. As the torque of the meter depends entirely on the rotating field produced by the current in the windings, it is practically independent of any stationary external field; the damping magnets can, therefore, be made of the strength required without affecting the accuracy. Magnetic damping is in general to be preferred to air dampers, as the resulting construction is more rugged and the clearances are greater. However, the torque of moving coil meters is so slight that air damping is sometimes preferred for them. Air damping would be entirely inadequate to properly control the high torque of induction meters.

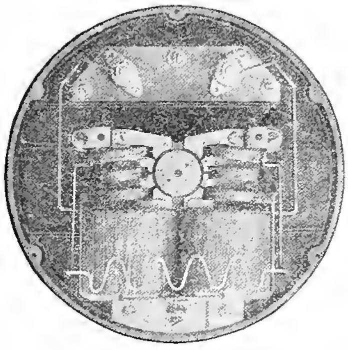
The general make-up of the Westinghouse induction type meters is exceptionally rugged. The movement, due to its design, is inherently strong, since it consists of but a shaft, an aluminum cup, a damping disk, and the pointer. All these



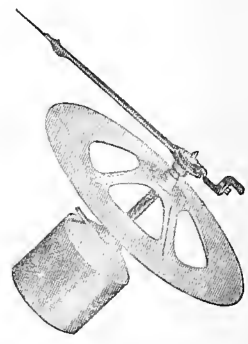
Seven-Inch Induction Meter—All Parts Except Electro-magnets Removed



Seven-Inch Induction Ammeter—Scale and Scale Plate Removed



Seven-Inch Induction Ammeter—Scale Removed



Simple Moving Element of Induction Meter

parts are made sufficiently heavy to withstand abuse in service and handling.

The entire electro-magnetic element of the meter is mounted on a die-cast alloy frame, which also contains the rear sapphire jewel and provides a mounting for the front bridge to which are fastened the spiral hair spring which controls the movement, the zero-adjusting clip and screw, and the front sapphire jewel. Both the frame and the bridge are doweled so that in case the bridge should be lifted off to permit the removal of the moving element it can be replaced exactly in its former position, thus insuring the proper alignment of all parts. The frame also serves as a support for the dial plate and cardboard dial.

The damping magnets are mounted on a metal clip which is fastened by four screws to the die-cast frame. This method of mounting permits the ready removal of damping magnets with the certainty of having them exactly the proper position relative to the rest of the mechanism when replaced. The rigidity of the mounting prevents any displacement of the magnets and damage to the movement, or contact with the aluminum damping disk due to rough handling of the meters in shipment.

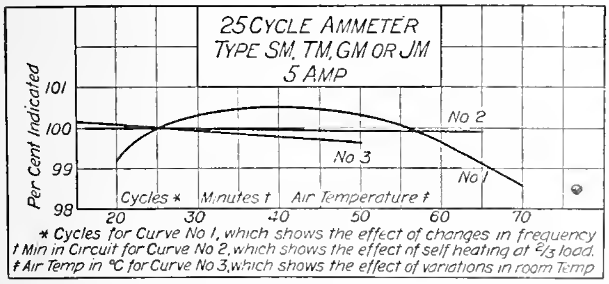
The jewels are of the highest grade sapphire, cut and polished in the same jewel department of the Westinghouse factory where the hundreds of thousands of sapphire jewels for watthour meters are prepared. The steel pivots, which fit into these jewels and carry the movement of the meter, are likewise ground and polished by experts and subjected to rigid examination and tests.

In the quality of the spiral spring used for the purpose of restraining or controlling the rotation of the movement, the performance of calibration largely depends. The spring is made of the finest phosphor bronze alloy, tempered, gold plated, and properly aged. The aging process is a source of treatment that aids the molecular rearrangement of the metal and allows the spring to take a permanent set which would otherwise be attained only after a prolonged period of natural aging. This artificial aging is followed by a period of natural aging, and the result is a spring that, when applied to the control of the moving element of a meter, insures absolute permanence of calibration.

The spiral controlling spring is held by a metal clip mounted on the bridge that holds the front jewel. This clip carries practically the entire weight of the spring, thus relieving the moving element of this weight. The clip also serves as a zero adjustment for the movement. The adjustment of the zero of the pointer is a very simple matter.

On removing the cover of a Westinghouse induction type meter, one is impressed by two things; first, the simplicity; and second, the high quality and beauty of workmanship and finish.

There is an entire absence of small screws, of delicate parts, in fact of anything that might be injured in ordinary handling. There are no moving wires or connections, no microscopic clearnes which might become clogged with a speck of dust or jammed, by the touch of a finger to a moving part. The possibility of inspection, adjustment, and repair by an ordinary man is apparent. An instrument specialist is not needed, nor is it necessary to "send the meter back to the factory."



Frequency, Temperature, and Self-Heating Characteristics of Westinghouse 25-Cycle Induction Ammeter.

Ordinarily the electrician or mechanic does not hesitate to repair any piece of electrical machinery in connection with a power plant, but, when it comes to a meter he throws up his hands with the idea that it is too delicate a piece of work for any one but a watchmaker or meter expert. The Westinghouse induction type of meter does away with this state of mind. The parts are accessible, they are few in number and the screws are ordinary machine screws, which can be handled without forceps.

It is the practice of some power companies to purchase all ammeters of five amperes capacity, and then apply them to one current transformer or another, as occasion demands, merely replacing the cardboard scale with one marked to the proper values for the indications of the pointer. The Westinghouse induction meter is admirably suited for this practice, owing to the ease with which the cardboard scale may be changed. It is not necessary to remove the meter from the board, nor to disturb the moving element or the mechanism of the meter in any way. The whole operation requires but a couple of minutes' time, and does not in any way disturb or effect the accuracy of the meter.

The weight of the moving element of the induction type Westinghouse meters is as light as is consistent with rugged construction. The torque is very high, in fact it has a value several times that found in any other type of alternating current meter. The result is a ratio of torque to weight that is exceptionally high—from four to six times that found in alternating current meters of other types. This is one of the most vital characteristics in the design of a meter, as a high ratio of torque to weight insures initial as well as long-continued accuracy.

The accompanying curves show the Westinghouse induction meters practically free from temperature and self-heating errors. They show that for any change in frequency that is likely to occur on a commercial circuit the accuracy of the meters is not affected. Add to all this the fact that the induction type meter is inherently free from influence by external fields, and it is self-evident that these meters can be depended on under all conditions of service.

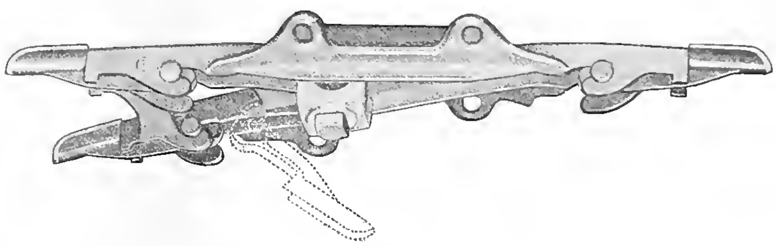
The Westinghouse induction meters are made in round cases 7⅝ inches and 9⅝ inches in diameter, also as large illuminated dial meters, and as vertical edgewise meters, 3, 4 and 5¼ inches wide.

NEW TROLLEY FROG.

The repair work on the overhead construction must be completed in a very short time to avoid tying up service when cars are running on short schedule and it is, therefore, important that a frog be simple in construction so as to minimize the operations necessary for installation, renewal of flexible tips and adusting of trolley wire.

The Frog shown in the illustration is a new design made by The Ohio Brass Company and consists of only six parts so that the time and labor necessary for its installation are considerably less than for a more complicated design.

The important feature of the Frog is the combination renewable bronze tips and cam wedge. This piece is made to slip under hooks on the pan casting and has a cam action upon the trolley wire, forcing it down into the bottom of the



Type D—Trolley Frog.

groove in the pan and holding it securely whether the wire be new or badly worn.

In installing, the wires are attached to the pan by the central clamp and a single machine bolt, after which the renewable tips are inserted under the hooks upside down with the ends pointing toward the center of the pan and are then forced over and outward until the lips enclose the wire ready to be peened around it—the final operation of the installation. In this position, the tips are interlocked with the end of the pan casting so that it is impossible for them to work out from under the hooks. When worn, the tips may be easily renewed without unfastening the wires from the pan casting.

The arms are provided with long gradual inclines which give an easy approach and the sides of the pan are flared outwardly at the ends to draw in any size wheel.

A deflector bar between the divering arms prevents the harp from being wedged should the wheel jump.

The Frog is made either all bronze with sherardized malleable iron pan and bronze tips, and is furnished for all sizes of wire.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—Telephone Users' Association, $10,000, shares $1 each, subscribed $3, by A. G. Rockel, C. E. Ward and G. D. Stein.

WILCOX, ARIZ.—New State Telephone & Telegraph Company has been incorporated by D. A. Adams, T. J. Riggs and H. A. Morgan, with headquarters at Wilcox. They will extend the service into new fields.

ILLUMINATION.

NEWBERG, ORE.—A 25-year franchise has been granted to the Yamhill Electric Company for lighting the city.

OROFINO, IDAHO.—The Welch interests of Portland have purchased the Orofino electric light and power plant and other rights. Immediate steps will be taken to improve the property.

LAKEPORT, CAL.—The Mt. Konocti Light & Power Company of Lake County has applied for authority to extend its service from Lakeport to Kelseyville, Blue Lakes and Upper Lake.

VENTURA, CAL.—The Ventura County Power Company is putting in a new lighting system for the city, which will be completed about August 1. Wire-drawn filament lamps will be installed.

KENNEWICK, WASH.—The Pacific Power & Light Company has just closed enough contracts to justify extending the lighting system to the Kennewick highlands. The proposed extension will light 150 homes.

HOUSTON, TEX.—Building permits calling for building and improvements to cost $175,000 have been issued. One was for two large gas holders to be erected by the Houston Gas & Fuel Company, in line with their proposed improvements. The total cost of the tanks is to be $170,000.

LOS GATOS, CAL.—The Los Gatos Light & Power Company has applied to the State Railroad Commission to sell its plant and franchises to the Pacific Gas & Electric Company for $187,000. The latter company has been buying these smaller plants in contiguous territory for some time.

LOS ANGELES, CAL.—A meeting of the stockholders of the Central California Gas Company will be held September 25th at 10 o'clock a. m. at the office of said company in the International Bank Building, corner Spring and Temple streets, for the purpose of considering and acting on the matter of creating a bonded indebtedness of said company in the sum of $500,000 to be evidenced by 1000 bonds of the denomination of $500 each.

FRESNO, CAL.—That the contract executed between the San Joaquin Light and Power Company, is only for temporary service, until the latter company can complete its new power house on the Tule River near Tulare, was the substance of a statement made by W. A. Sutherland, speaking as attorney for the San Joaquin Company. The contract calls for 1000 h.p. to be sold to the Tulare County Power Company. According to Sutherland, the Tulare Company is composed largely of former patrons of the Mt. Whitney Company. The recent decision of the Railroad Commission, allowing the San Joaquin Light & Power Company to extend its line into Tulare county, will now permit the company to rush work on its 50,000-volt line through the county. It is expected that this work will soon start.

SACRAMENTO, CAL.—A readjustment of rates in portions of Shasta and Tehama counties, in response to the application of the Northern California Power Company has been made by the Commission, following the rate war there with the Sacramento Valley Power Company. The Northern Company recently absorbed the other and asked to be allowed to raise rates to the old basis. It was found by the Commission that the rate war had forced returns below a profitable plane and it was allowed a maximum lighting rate at 9c a kilowatt instead of the 10c asked by the company. The Commission found that the company had declared a valuation of $20,000,000 upon its property. It developed that $11,000,000 had gone into the property and that the company claimed the balance for water rights. The Commission takes the stand that the par value of the stocks and bonds does not furnish a standard for rate-fixing purposes. It discusses the suggestion that hydroelectric power companies be allowed to capitalize their water rights. No ruling is made, but the Commission refers to the proposal for such capitalization as a desire to capitalize the "generosity of the public."

TRANSMISSION.

BAKER, ORE.—The Idaho-Oregon Power Company, with offices in Boise, announces that it will enter this field with its power lines.

ROSEVILLE, CAL.—The Commission has granted the application of the Great Western Power Company to extend its lines to Roseville, Placer County.

SPOKANE, WASH.—Harvey N. Ross, secretary and manager of the Nabob Mining Company, and C. F. O. Merrian, the chief engineer, have closed a contract with the Washington Water & Power Company for the construction of a high potential line from Wardner to the Nabob mine and for furnishing power to operate the compressor plant.

BELLINGHAM, WASH.—To handle the electric power that will be brought to the city from the Stave Lake Power plant for the use of the Whatcom County Railway & Light Company, a high-power switching station will be constructed at once near the site of the present power plant. The foundation is now being laid for the building, which will be 50x100 ft., of brick and steel.

LOS ANGELES, CAL.—The Pacific Light & Power Corporation has levied an assessment of $5 per share, delinquent August 30. The outstanding stock is $1,207,000 first preferred, cumulative; $10,000,000 second preferred, and $12,207,000 common. Surplus for dividends last year was $594,000. It is presumed that the assessment is made for construction work on the Big Creek power plant.

LOS ANGELES, CAL.—The Southern California Edison Company reports earnings for May and for five months ended May 31:

May 31:	1912.	Increase.
May Gross earnings	$348,688	$60,257
May net	166,216	25,465
Surplus	107,614	21,869
Five monhts gross	1,741,441	272,903
Five months net	843,019	107,446
Surplus	542,390	83,625

PHOENIX, ARIZ.—The Miami Copper Company and the Inspiration Consolidated Copper Company want to enter into a ten-year contract to purchase all the surplus electric power generated under the Salt River project. They agree to build an auxiliary steam plant, also to build a transmission line from Roosevelt to Miami. In about six months the 1000 h.p. plant at Arizona Falls will be finished. Another plant is to be built on the New Crosscut canal that will generate 600 h.p. About 30,000 h.p. will ultimately be developed under the Salt River project.

SAN FRANCISCO, CAL.—The Pacific Gas & Electric Company reports for the five months ended May 31st as follows: Gross earnings, $6,277,512; expenses, including taxes and reserves, $3,428,815; net earnings, $2,848,697; bond and other interest, $1,420,643; net income, $1,428,054; bond dis-

count and expense, $41,552; preferred stock dividends, $300,000; common stock dividends, $365,169; surplus for depreciation and other purposes, $721,333. During the five-months' period covered by the above statement the company gained 8300 new consumers. Gas sales, as compared with the same period of 1911, increased more than 245,000,000 cubic feet, and at the present rate will exceed those for 1911 by 600,000,000 cubic feet. The electrical business of the company also is growing at a most satisfactory rate. Contracts for more than 10,000 horsepower were signed up in the six weeks since May 31st, or at a rate of 1600 horsepower a week. This growth was well distributed over the entire system, the average of these contracts being about forty-five horspower each.

PORTLAND, ORE.—The Portland Railway, Light & Power Company for the month of May shows earnings of 6.22 per cent and for the five months ended May 31 of 5.5 per cent, on its $25,000,000 stock. While gross earnings for the month gained 3 per cent and for the five months 4.3 per cent, the surplus for the stock for the month showed a decrease of 19.9 per cent, and for the five months a decrease of 18.1 per cent from the corresponding periods of 1911. The decrease in surplus earnings was due to the increased operating expenses and the larger interest charges. For the month the cost of operating increased 8.6 per cent, and for the five months increased 10.3 per cent. This was largely caused by an increase in the taxes levied on the property by the city and county. Interest charges for May increased 22.2 per cent and for the five months increased 17.8 per cent. This increase in fixed charges came because of the issue of additional bonds and the sale of $5,000,000 notes to pay for the Mt. Hood Railway Company. The earnings of the Mt. Hood Company have not yet begun to show to any appreciable extent in the gross of the company, but with the completion of work now under way they are expected to add materially to the earnings of the company. The last seven months of the year have always been the best for the company, and by the close of 1912 it is believed that the present decrease in surplus earnings will be wiped out and as large earnings shown for the stock as in 1911, when 7 per cent was earned on it. Dividends at the rate of 1 per cent quarterly are being paid on the $25,000,000 of stocks.

TELEPHONE AND TELEGRAPH.

KLAMATH FALLS, ORE.—The Pacific Telephone & Telegraph Company will begin at once on the new common battery telephone system in this city.

CUCAMONGA, CAL.—The Ontario & Uplands Telephone Company is reported to have decided to establish an exchange in Cucumonga, so that all local business will be handled there.

CONCRETE, WASH.—Mrs. K. Glover, manager of the Skagit River Telephone Company, is looking over the country with a view of extending the lines from Rockport to Marblemount.

BOISE, IDAHO.—The City Council will advertise for bids for installing an underground cable system. The Board of fire underwriters insists that fire alarm wires be placed in cables not used by the telephone company.

FULLERTON, CAL.—Bids will be received up to September 2 for a franchise granting the right to construct poles, wires and other appliances and conduits for transmission of electricity for telephone and telegraph purposes.

PASADENA, CAL.—With the issuance of a permit to the Home Telephone Company to make alterations in its building at 68 N. Raymond avenue, actual work has been begun on the consolidation of two companies now operating in this city.

LINDSAY, CAL.—The Railroad Commission has denied the application of the Lindsay Home Telephone & Telegraph Company to raise its suburban rate from $1.50 a month to $2.50 a month. The Commission granted a special rate of $1.75 for desk telephones.

TRANSPORTATION.

RIVERSIDE, CAL.—A contract was closed this week by the Pacific Electric Railway with the Riverside-Portland Cement Company for the delivery of 15,000 tons of crushed rock to be used in rebuilding the Magnolia and Colton avenue electric line.

EL SEGUNDO, CAL.—The citizens of El Segundo are expecting to have the Pacific Electric Company run their cars into town within the next 30 days. A complete right of way has been secured, and only about two miles of track will have to be laid to connect the road already built out of El Segundo with Hawthorne.

LOS ANGELES, CAL.—City Engineer Hamlin's estimate of the cost of the proposed municipal railroad to the harbor is $2,268,551 with a probable additional cost of $2,000,000 for right of way and damage to property. The estimate includes plans for 4.72 miles of double track and pavement on streets, and 15.56 miles of double track on private rights of way.

SAN FRANCISCO, CAL.—The State Railroad Commission has rendered a decision granting the Northern Electric Railway Company, permission to issue $600,000 of 5 per cent bonds. The original application was for $1,100,000. The applicant later asked that $600,000 in bonds be allowed at this time and the remainder be considered at a later date. The Commission granted this request. The proceeds of the present issue will go toward the construction of the Marysville and Colusa branch of the Northern Electric and for a branch across the Sacramento at Meridian.

SAN FRANCISCO, CAL.—An application has been filed with the Railroad Commission by the Anglo-California Trust Company and the United Railroads for the authorization of the purchase of 65 street cars at a price not to exceed $365,000, or a little less than $6000 a car. The trust company will act as the trustee. The cars will be purchased direct from the manufacturer and held by the Trust Company. They will be paid for as they are needed by the United Railroads. In the application it is stated that the parties to the application do not believe the deal comes under the powers of the Railroad Commission, but they have made the application to settle any doubt.

SAN FRANCISCO, CAL.—John Rosene, the Seattle capitalist who is at the Palace, says: "I am seeking a concession for the mono rail means of transportation from the Exposition people here. I want to build it through the Exposition grounds by way of the Presidio to Golden Gate Park. In connection with Judge R. Fitzpatrick of Redwood City, I may also build one of these roads between Redwood City and Woodside in San Mateo county. Regarding the standard railroad for Alaska in which I am interested with a Canadian syndicate, I can say that it is about 800 miles long, starting from Haines, on the Lynn Canal, and ending at Rampart on the Yukon. It is to run through the Fairbanks country. The new road will have a mileage of about 540 in Alaska and some 275 on Canadian territory."

SAN FRANCISCO, CAL.—Plans prepared by the quartermaster's department to extend the Presidio electric line through the Presidio to Fort Winfield Scott are being considered by the War Department. The extension to the present line will take a circuitous route to Fort Winfield Scott, necessitating about three miles of track. It will start at the terminal of the Union street line, in front of the Letterman General Hospital, in the Presidio, and proceed along the south drive and around the back of the bachelor quarters. From this point it will continue to the base of Infantry terrace, thence swinging over the flat to the upper end of the infantry quarters, to the rear of the national cemetery into Fort Winfield Scott reservation, up the hill and past the barracks to the old brick fort at the Golden Gate.

ALPHABETICAL INDEX TO ADVERTISERS

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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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Where to Buy It in the West, Pages 9, 10, 12

Alphabetical Index to Advertisers, Page 8.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXIX SAN FRANCISCO, AUGUST 3, 1912 NUMBER 5

POWER DISTRIBUTION FOR SEATTLE MUNICIPAL PLANT

BY J. D. ROSS.

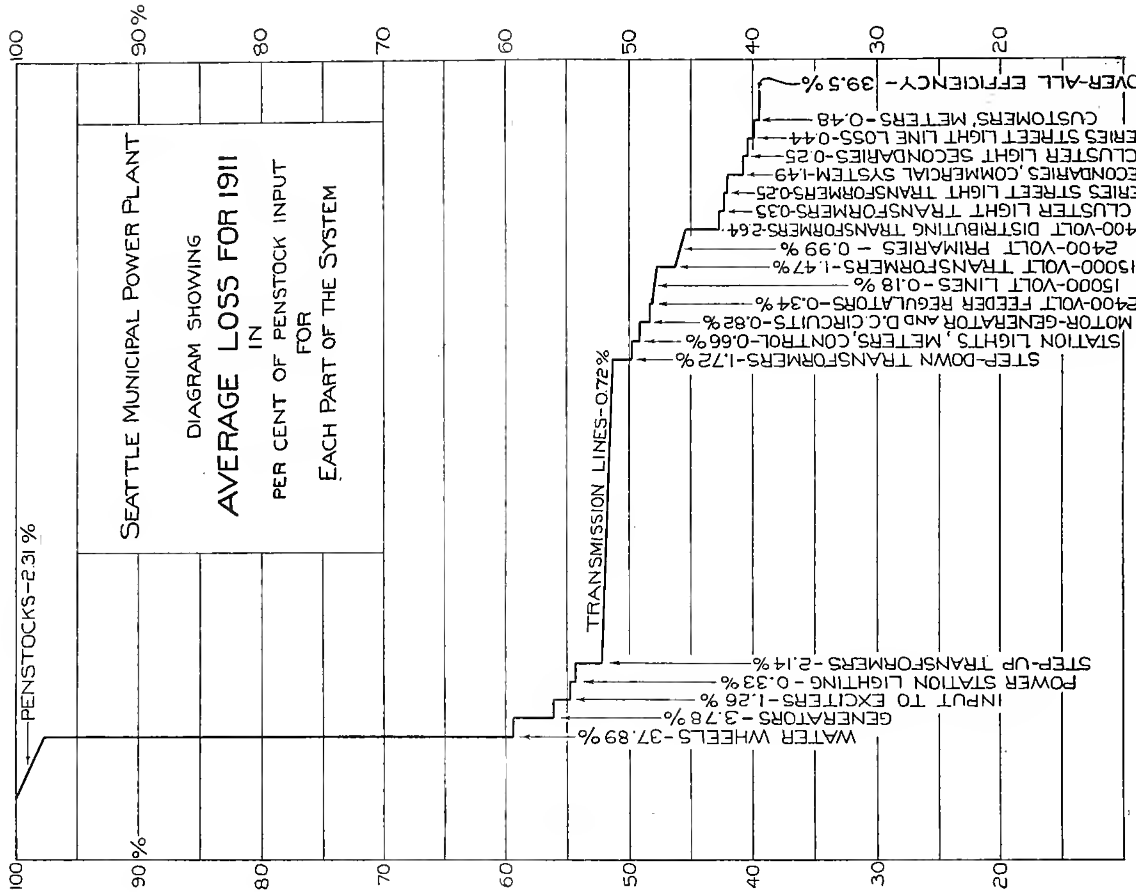
The Cedar River plant connects with the substation 38.7 miles distant in Seattle at Seventh avenue and Yesler Way by means of two transmission lines. The first of these lines built in 1904 consists of No. 2 solid B. &. S. gauge medium hard copper wire on Pittsburg insulators 14 in. in diameter. The poles are from 55 ft. to 85 ft. in length and with not less than 11 in. top. They are placed from 450 to 800 ft. apart except on curves and within the city. Corners are turned on two poles. All ravines and gulleys are spanned and the line is entirely dry and not influenced by floods.

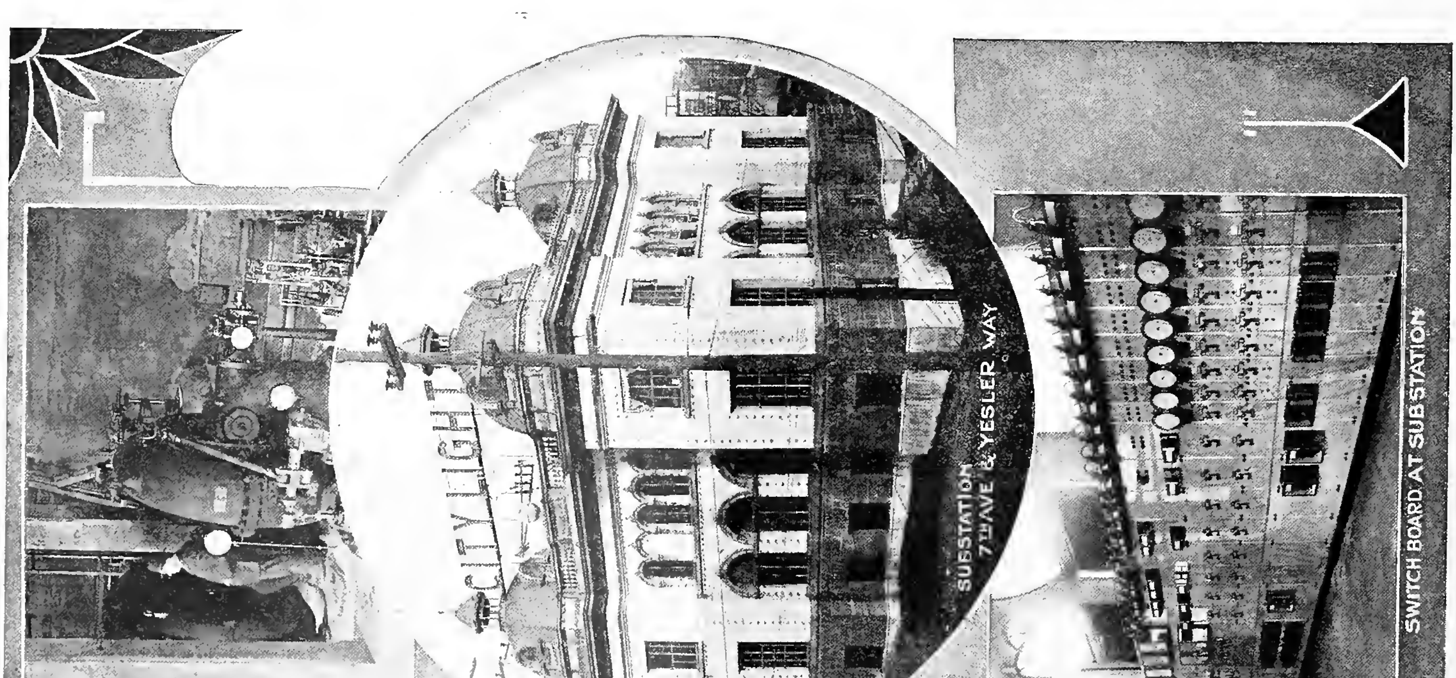
FOURTH AVENUE, LOOKING NORTH FROM YESLER

The wires are placed 6 ft. apart. The poles are of cedar 40 ft. in length, with 9 in. tops and placed 140 ft. apart. This line also carries a No. 11 copper telephone line.

The second line built in 1908 consists of No. 0000 seven-strand hard drawn copper cable placed in 7 ft. triangle on No. 3037 Thomas triple petticoat insulators. The cross arms are 8 ft. 4 in. by 6 x 8 in.

The spans are computed for a factor of safety of four and were sighted in, with corrections for temperature. This line is the only one of its kind in the country and has proven perfectly satisfactory, no failure having developed to date in spite of the high winds that it has passed through. This pole line carries a telephone line 15 ft. below the power arm consisting of seven strand 3/16 in. plough steel cable. This line is


SEATTLE MUNICIPAL POWER PLANT
DIAGRAM SHOWING
AVERAGE LOSS FOR 1911
IN
PER CENT OF PENSTOCK INPUT
FOR
EACH PART OF THE SYSTEM
PENSTOCKS-2.31 %
WATER WHEELS-37.89 %
GENERATORS-3.78 %
INPUT TO EXCITERS-1.26 %
POWER STATION LIGHTING-0.33 %
STEP-UP TRANSFORMERS-2.14 %
TRANSMISSION LINES-0.72%
STEP-DOWN TRANSFORMERS-1.72 %
STATION LIGHTS, METERS, CONTROL-0.66 %
MOTOR-GENERATOR AND D.C. CIRCUITS-0.82 %
2400-VOLT FEEDER REGULATORS-0.34 %
15000-VOLT LINES-0.18 %
15000-VOLT TRANSFORMERS-1.47 %
2400-VOLT PRIMARIES - 0.99 %
2400-VOLT DISTRIBUTING TRANSFORMERS-2.64
CLUSTER LIGHT TRANSFORMERS-0.35
SERIES STREET LIGHT TRANSFORMERS-0.25
SECONDARIES, COMMERCIAL SYSTEM-1.49
CLUSTER LIGHT SECONDARIES-0.25
SERIES STREET LIGHT LINE LOSS-0.44
CUSTOMERS' METERS-0.48
OVER-ALL EFFICIENCY - 39.5 %
100
90 %
80
70
60
50
40
30
20


SUBSTATION 7TH AVE & YESLER WAY
SWITCH BOARD AT SUBSTATION

transposed every 3100 ft. and the power line is transposed every 12,400 ft. Telephone transformers made in the city shops are used with grounded secondaries for all telephones. The two power lines are each cut into three sections with cross over air switches so that any defective section may be cut out. Millions of feet of heavy timber were cut, leaving nothing that can touch either line. At the substation end the lines are equipped with overload and reverse current time limit relays.

The lines are normally operated in multiple and measurements show that their combined efficiency at the average load of 1911 is 98.68 per cent.

The step down transformers are placed on the first floor of the substation. There are at present eight of these, each of 1500 kw. capacity at 35 degrees C. temperature rise. All are made with a ratio of 54,000 three-phase to 15,000 and 2500 Scott connected two-phase making four banks of transformers. The secondary coils are connected in series for 15,000 and in multiple for 2500 volts two banks being used for each voltage. Under careful test these transformers showed a maximum efficiency of 98.5. The all-day efficiency was found to be 96.60 per cent for 1911.

The distributing system was first designed for three-phase star connection but as there were two large companies in the city both operating two-phase the plans were changed to make it possible to interchange motors without special transformers.

Main Substation.

The city main substation at Seventh avenue and Yesler Way is a concrete and brick building of artistic design. The 60,000 and 15,000 volt switches and wiring are placed on the second floor. The transformers, motor generator set and switchboard on the first floor and the 2500 volt busses, switches and regulators in the basement. The switchboard designed and built in the shops of the department is 43 ft. 4 in. long, including the street lighting board, entirely of blue Vermont marble. The transformer panels are 20 in., the feeder panels 10 in., and the series arc panels 10 in. wide by 90 in. high, including 28 in. sub-base, by 2 in. thick, polished both faces and having ½-in. bevel. Alternating current and direct current instruments are horizontal edgewise type. The board is equipped with a complete set of curve tracing Westinghouse meters for recording frequency, power factor, voltage and wattage, on both high tension lines. Automatic feeder regulation is used throughout. At first, in 1907, G. E. type B. R. regulators were used but the G. E. induction type has been found more reliable and better and new circuits are being equipped with them.

All switches are electrically operated and the board contains no higher than 125 volts. All control devices are operated from a separate 25 kw. 125 volt current generator direct connected to an a.c. motor. A small storage battery has been added to serve emergency station lighting circuits and operate switches in any emergency.

Street circuits are supplied from 6.6 ampere 100-light G. E. air-cooled constant current transformers. Each of these is equipped on the primary side with a small oil switch electrically operated, made by the department, and a small test board with plug switches. This arrangement allows of the main switchboard being merely a 125-volt control board.

A motor generator set consisting of a 750 h.p. two-phase synchronous motor direct connected to two 250 kw. 250-volt direct current compound wound generators is used on a three-wire 500 and 250-volt system for operating elevators and other motors. The maximum load on this machine at the present time on the direct current side is 300 kw. and the average load for 1911 was 30.2 kw. The surplus kilovolt-ampere capacity of the motor is utilized in regulating the voltage of the main system by varying the power factor by means of a Tirrill regulator controlling the field of the motor. The all-day efficiency of the motor generator was during 1911, 38 per cent and the efficiency of the distributing direct current system is estimated to be 95 per cent. The direct current system was installed in order to accommodate the patrons of the plant who do their lighting from the a.c. mains and so enable the plant to better compete for large business loads.

There are at present 71 services connected on this system with a connected load of 772½ h.p. The main feeder is 750,000 c. m. cable with a 400,000 c. m. neutral, and the branches usually No. 4/0 with No. 2/0 neutral. In all, 27 miles of wire are used on this system.

15,000 Volt System.

A municipal plant must adhere to uniform rates at all distances from the station much more closely than a private concern, although the cost of current delivered in distant suburbs is greater; the question of cheap transmission to suburbs has therefore been carefully studied. The economic distance to which 2500 volts could be carried was computed from the cost of material and labor, interest on bonds, and net value of current per kw. annum, and beyond the economic distance substations were installed at 15,000 volts and distributing at 2500 volts giving better economy and regulation. One of these at Fremont, distant 19,200 ft. from the substation, has a capacity of 1500 kw. at 40 degrees C. temperature rise. Another at West Seattle, 26,000 ft. distant from the substation, has a capacity of 500 kw. at the same rating. A similar substation has been completed at Hillman and a site purchased for one in Ballard. For mechanical reasons No. 2 is the smallest wire used for 15,000 volt transmission. These lines travel largely along the water front on Puget Sound where there are a number of large power users and along Lake Union where the new canal will bring a considerable number of industries. In all, these lines traverse 10.7 miles of waterfront and will eventually follow the entire water front of both salt and fresh water.

It is obvious that some system would be ideal that would supply all large industries from the 15,000 volt lines direct, leaving only the lighting of the suburbs beyond to be handled by the substations, thereby requiring much smaller transformers and giving vastly better regulation. It was also desired to use pole type transformers except for very large loads. A three-phase star system was the nearest approach to the ideal then in use and a system was therefore designed for the purpose, using a two-phase 15,000 volt system, the center point of each transformer being brought out and connected to a fifth wire which was

grounded frequently along the line. This system gives in reality four circuits for the two phases. Power is transmitted at 15,000 volts but is distributed along the line for large power and lighting loads at 7500 volts, stepping to the supply voltage desired. To this end 7500 volt transformers are placed on poles in the usual way and connected from the outside wire of a phase to the neutral wire as in the ordinary three-wire system. Submarine cables have 15,000 volts between wires but only 7500 volts to lead sheath. This system has given entire satisfaction and makes substation work easier by eliminating large power loads from the automatic regulators.

2500 Volt Distributing System.

Power is distributed from the substations by means of seventeen 2500 volt primary feeders. Of these, twelve are fed from the main substation at Seventh avenue and Yesler Way, three from Fremont substation and two from West Seattle substation. The heavier loaded circuits were designed for 200 amperes, and the lighter ones for 150 amperes. Number 4/0 wire was used at first, but the economic size for a 200 ampere feeder has been computed at 350,000 c. m., which size is now used on the heavier feeders.

An area of 28 square miles is served by this system extending seven miles south and six miles north of Yesler Way. A distributing point is established at the approximate center of distribution for each feeder, and the automatic regulators in the station are set to give the desired voltage at this point. This voltage is regularly checked by placing a recording volt-meter at the distributing point, and any variation from normal is noted and corrected.

Connected to the 2500 volt feeders are 1082 distributing transformers, ranging in size from 2½ kw. to 50 kw., and with an aggregate full-load capacity of 9268½ kw. They are connected to give a 250-125 volt three-wire secondary, with the neutral grounded. To aid regulation, a number of transformers of the same size and type are usually connected together on the secondary side where conditions will permit. Since the department is extending its lines to every suburb, there are many scattered communities in the outlying districts where one or two transformers are sufficient to carry the load. It is this condition that makes the problem of regulation difficult, and requires heavy copper and careful attention to the station feeder regulators. The secondary wire is generally No. 4 for the outside wires and No. 6 for the neutral, with No. 8 for the services. The maximum voltage drop from transformer to customer is kept within 2 volts whenever possible, since there is no way of regulating for voltage between these points. The pressure at the service is kept as near 120 volts as possible. Although standard 2200-110 volt transformers are used, the pressure has been raised to 2500 volts. This gives about 25 per cent higher core loss, but lowers the copper loss in both transformers and feeders about 29 per cent, and in addition gives nearly 14 per cent better regulation. The 2500 volt system requires 545.4 miles of primary wire ranging in size from No. 6 to 350,000 c. m. and 1,137.1 miles of secondary wire, varying from No. 6 to No. 4/0. To carry this wire 17,602 poles are required.

The all-day efficiency of the 2500 volt distributing system for 1911 was 78.0 per cent. This is the ratio of the power sold to the output of the substations. The transformer losses were computed from careful tests made on each type and size of transformer under actual operating conditions. The line losses were computed from the load curves taken at distributing points and at the stations, and checked by recording voltmeter charts taken at the same points. The loss in customers' meters is computed on the basis of tests taken by the meter department.

By Ordinance No. 21655, effective September 12, 1909, all overhead wires in the district bounded by First avenue, Cedar street, Fifth avenue and Jackson street were ordered underground, and three years was set as the time for making the change.

The lighting department already owns 262,000 duct feet of vitrified clay conduit in the streets, exclusive of that used for cluster lights, and has arranged for the installing of approximately 500,000 duct feet of vitrified clay during 1912.

The underground feeders will carry 7500 volts and 2500 volts, feeding from 15,000 volt transformers having the center tap grounded. The secondaries will be a 250-125 volt three-wire system. All underground cable will be lead-covered, with varnished cloth insulation. The underground system, as well as all of the distributing system, is designed to care for the probable future demand with the least possible reconstruction.

Lake Union Auxiliary.

A 5000 kw. steam auxiliary in Seattle to supply power over a possible dry season and to give relief during accident to the water power plant is now under consideration and all plans completed. An attempt was made to find a suitable system of gas engine drive, but owing to the character of the oils and coals of the Pacific Coast, the attempt was abandoned until this line of apparatus is better developed in the large units.

The need for a plant capable of immediate action in emergency was met, however, by installing a hydro-electric plant using the excess water of the city water works. This plant is situated on the east shore of Lake Union and receives its water supply through a 40-inch riveted steel pipe 3400 feet long from Volunteer Park reservoir which is at 412 feet elevation above Lake Union. This plant has a capacity of 2000 h.p. and operates at 2500 volts two-phase connecting directly with the main substation at Seventh avenue and Yesler Way through heavy stranded aluminum cables. This plant is now installed and will immediately care for a considerable load during emergency.

It is intended that the steam plant will be situated on the same site which will be accessable for its fuel supply from the Northern Pacific Railway or by the new Lake Washington canal. It is intended to install duplicate steam turbines. The water of the boilers will be kept hot from an electric heating coil during off peak hours so that quick action may be had in emergency.

Series Street Lighting System.

The series street lighting system comprises 683 miles of No. 6 wire divided into 29 circuits, lighting 601 miles of streets. The circuits are connected two in series to 6.6 amperes 100 light air cooled General Electric constant-current transformers. Each of these

is equipped on the primary side with a small solenoid-operated oil switch made by the department, and with a test board with plug switches. This arrangement keeps all pressures above 125 volts away from the switch-board. The voltage on the circuits varies with the number and kind of lamps from 2500 volts to 5000 volts. In all there are 692 6.6 ampere arc lamps, 5315 40 c.p. tungsten lamps, and 199 300 c.p. tungsten lamps. The large tungsten lamps were manufactured especially for the department. They have proved satisfactory in every respect, giving steadier, better distributed light and averaging over 2000 hours of life. The 40 c.p. tungstens are mounted by "goose-necks" on the line poles. This type of lamp is ideal for its purpose since it gives light in small units at a minimum cost of maintenance and power.

The test of the series lighting circuits shows an all-day efficiency for 1911 of 86.3 per cent from the switchboard to the lamp. The loss in the transformers was 5.0 per cent, and in the line, 8.7 per cent.

Cluster Lights.

Seattle's cluster lighting system is one of the finest in existence and is generally admired by tourists and visitors from all parts of the country. The main business avenues are lighted by five-lamp poles, placed opposite each other at the curb line and spaced at eighty and ninety feet. The usual design of a five-lamp pole places four globes in the form of a cross, with one center top globe. The Seattle poles, however, have the lamps placed in a triangle perpendicular to the sidewalk, with a 16-in. globe at the top, two 14-in. below, and two 12-in. globes, turned downward, at the base of the triangle. All the globes have a light sand-blast finish. This design gives a beautiful effect of festoons of decorative lights along the sidewalks, and at the same time secures a uniform illumination on all parts of the street. The intensity on the sidewalk varies from 0.32 to 0.79 foot-candles, and at the center of the street from 0.34 to 0.45 foot-candles. This illumination, which is ample, is produced by using 50-watt tungsten lamps fed from a small transformer in the pole base at a pressure of 8 volts. This type of lamp was designed by the General Electric Company especially for the lighting department, and has proved so satisfactory that it has since been made standard by that company. The average life of this lamp has proved to be over 2000 hours.

In residence districts, where lower illumination is sufficient, three-globe poles are used, similar to the five-globe poles with the two lower globes omitted. In the parks and along the driveways a single 20-in. globe with a 75 watt 12½ volt lamp is used. Altogether there are 1116 five-ball poles lighting 13.5 miles of street, 378 three-ball poles lighting 8.5 miles, and 137 one-ball poles lighting 3 miles of street, making a total of 1631 poles lighting 25 miles of street.

In the business district the system is fed from underground mains placed near the curb line. The main feeders are placed in vitrified clay duct with the commercial feeders, and the branches are run in fibre conduit cased with concrete. An exception to this is made when the ducts run under the walk where a basement is to be excavated. In these places steel conduit is used, placed just beneath the sidewalk. Manholes for transformers are placed below the sidewalk at street corners, about three blocks apart. Five, ten and fifteen kilowatt transformers are used, all on one street being alike. These transformers are connected to feed both ways from the manhole, the lamps in each section of street being fed from one secondary coil of each adjacent transformer. A three-wire lead-covered secondary cable is used, so connected that the blowing of a fuse will leave each alternate pole dark, and so leave the street still fairly well lighted. The secondary voltage is 120-240 stepped down to 8 volts by the pole base transformers.

The cluster lights in the business section are controlled from the substation. The cluster light poles were designed by the department, and made in Seattle. The idea of using low voltage lamps and transformers originated with the Seattle lighting system, the first low voltage transformers used in street poles being designed and built in the city light shops while the first low voltage tungsten lamps used for them were made by the General Electric Company by request of the department. This system gave over 2000 hours life to the lamps and the system has been rapidly adopted all over America.

INCREASING BOILER CAPACITIES.

The United States Bureau of Mines makes the statement in Bulletin 18 on the Transmission of Heat Into Steam Boilers, just issued, that the present steaming capacities of steam boilers can be tripled or quadrupled by forcing over the heating surfaces three or four times the weight of gases now passed over them. With well-designed mechanical-draft apparatus this greater weight of gases can be forced through the boilers at small operating cost.

The principles governing the combustion of fuel in boiler furnaces and the absorption of heat by boilers have been little understood. The dogmas that the area of grate should have a certain ratio to the area of the heating surface, and that it takes 10 square feet of heating surface to make one boiler horsepower, seemingly had become so thoroughly fixed in the mind that they were hardly ever questioned. It is only within the last decade that a few engineers have broken away from the old rule of thumb methods and have begun to investigate the functions of the boiler and furnace separately. Their studies seem to mark the beginning of advance in steam-generating apparatus.

The boiler is the metallic vessel that contains water and steam and absorbs heat; consequently it should be studied as a heat absorber.

The furnace is that part of the steam-generating apparatus in which the potential energy of the coal is changed into heat; consequently it should be studied as a heat generator.

GATUN DAM SPILLWAY, PANAMA.

The concrete work in the Spillway of Gatun Dam is over 89 per cent completed, 201,748 cubic yards, out of a total of 225,000, having been placed at the close of work on June 22.

ELEMENTS OF HYDRAULIC ENGINEERING

CALCULATION OF SPECIFIC SPEED.

BY GEO. J. HENRY JR.[1]

In the preceding article of this series[2], some general formulae were developed to establish a clear understanding of what takes places in the action of a water wheel. To pursue the reasoning a little further it will be seen that if the pitch circle of a tangential wheel runs at from 42 to 47 per cent of the spouting velocity corresponding to the effective head at the gate or nozzle inlet its velocity will be $\frac{42 \text{ to } 47}{100}\sqrt{2gh}$. If we take 45 per cent of the spouting velocity as a mean value we would have

$$\frac{\pi D_p n}{60 \times 12} = \frac{45}{100}\sqrt{2gh} \quad \ldots\ldots (17)$$

where D_p = pitch diameter in inches and n = revolutions per minute.

Transposing,

$$n = \frac{7.2 \times 45 \times 8.025\sqrt{h}}{\pi D_p} = \frac{827.2\sqrt{h}}{D_p} \times \text{Constant} \quad \ldots (18)$$

$$\text{and } D_p = \frac{827.2\sqrt{h}}{n} \times \text{Constant} \quad \ldots (19)$$

Table IV enables us to at once determine the revolutions per minute or the pitch diameter for any runner for a given peripheral velocity because from (18) and (19)

$$n D_p = \text{Constant } \sqrt{h} \quad \ldots\ldots (20)$$

If therefore we select the proper constant from this table and multiply it by the square root of the head and divide the result by the pitch diameter in inches, we will have the revolutions per minute the wheel should run, or if we divide the result by revolutions per minute we will have the pitch diameter in inches of the wheel.

In order to use the table most effectively, we must make an intelligent selection of the constant, and to do this, some further consideration is necessary.

It is seen above (20) that the speed (revolutions) varies as $\sqrt{h}$ and therefore we can say that for any given wheel which runs at n revolutions per minute under h head, the number of revolutions it should run under one foot head would be

$$n_1 = \frac{n}{\sqrt{h}} \quad \ldots\ldots (21)$$

Example 5: What will be the pitch diameter of a wheel whose pitch circle runs at 45 per cent of the spouting velocity under 490 ft. head if we wish it to deliver its best efficiency at 560 r.p.m.?

then $n = 560$ and $h = 490$, hence

$$D_p = \frac{827.2\sqrt{490}}{560} = 32.7 \text{ in.}$$

Example 6: At what speed should the wheel in Example 5 run if the head be reduced from 490 ft. to 1 ft.?

$$n_1 = \frac{560}{\sqrt{490}} = \frac{560}{22.13} = 25.3 \text{ revolutions per}$$

minute, and as shown in (4) the power output $\text{h.p.} = \frac{Q \times 62.4 \times h}{550}$ can be expressed as equal to a constant times a v h. In other words the energy E is a function of the velocity v times the head h., or as v is a function of $\sqrt{h}$ we may write

$$E = f h \sqrt{h} = f h^{3/2} \quad \ldots\ldots (22)$$

It is therefore clear that if a certain horsepower P is developed by a given wheel under a given head then under 1 ft. head the same wheel and nozzle will develop $\text{H.P.}_1 = \frac{\text{H.P.}}{h^{3/2}}$ ......(23)

Example 7: If the wheel in Example 5 with a 2 in. circular diameter jet, as in Example 3, should give 172 h.p. under the head of 490 ft., what h.p. should it give under 1 ft.?

$$\text{H.P}_1 = \frac{172}{490\sqrt{490}} = \frac{172}{10844} = .01576$$

For the purpose of comparing different wheels with one another, and for determining what any wheel under one head may be expected to accomplish under another head it is customary to reduce them to unit conditions and express this constant for the runner as that speed at which it should run under 1 ft. head when developing 1 h.p. and this is generally termed the specific speed.

By (21) we find the speed of any runner under 1 ft. head and by (23) the horsepower under 1 ft. head.

If we have a wheel of diameter D_p running at n_1 revolutions under 1 ft. head and if the jet impinging on the buckets is of area a, it is obvious that if we vary all the linear dimensions of the wheel so as to keep the same design proportions that the area a will vary as D^2 or D varies as $\sqrt{a}$. But as the area of the jet is proportional to the h.p. and D is proportional to the revolutions we may write

$$D \text{ and } n \text{ vary as } \sqrt{\text{H.P}} \quad \ldots\ldots (24)$$

Therefore we may write the specific speed (S) at which any given wheel will run under 1 ft. head when of such proportions that it will develop 1 h.p. and

[1]Consulting Hydraulic Engineer, Rialto Bldg., San Francisco.
[2]May 25, 1912, and June 1, 1912, for correction of errata.

% of Spouting Velocity	42	43	44	45	46	47	55	60	62	63	61	65	66	67	68	70	72	74	77	80
Constant for use in formulae	770	790	808	827	845	863	1010	1103	1140	1158	1176	1195	1213	1231	1250	1286	1323	1360	1415	1470
	Tangential Wheels.						Francis Turbines.													

$N \times D_p = \text{Const.} \sqrt{h}$.

Table IV—For determining revolutions where pitch diameters are known or for determining pitch diameters where revolutions per minute are known.

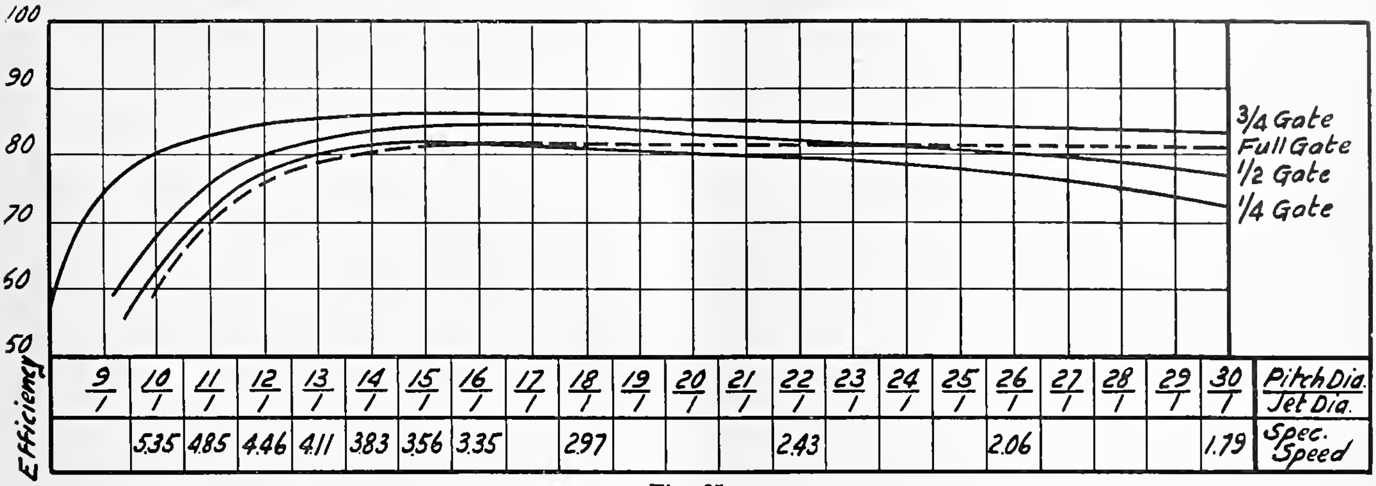


Fig. 25.

which was originally designed for n revolutions under h ft. head as:

$$S = \frac{n}{\sqrt{h}} \times \sqrt{\frac{h.\ p.}{h\sqrt{h}}} = \frac{n\sqrt{h.\ p.}}{h\sqrt[4]{h}} = \frac{n\sqrt{h.\ p.}}{h^{5/4}} \quad (25)$$

and in metric units S_m=4.42 S.

Example 8: What will be the specific speed of the wheel in Examples 6 and 7?

$n_1 \sqrt{h.p._1} = 25.3 \sqrt{.01576} = 3.17 = S$, and in metric units $= S_m = 3.17 \times 4.42 = 14$.

A careful review of all the reliable data I have been able to collect indicates that the best efficiencies

PD/d	10/1	11/1	12/1	13/1	14/1	15/1	16/1	18/1	22/1	26/1	30/1
Spec Speed	5.35	4.85	4.46	4.11	3.83	3.56	3.35	2.97	2.43	2.06	1.79
	Efficiencies										
Full Gate	60	70	76	79	80	81	82	82	82	81	81
3/4	80	83	84	85	86	87	86	86	85	84	83
1/2	68	75	80	82	84	84	84	84	82	80	77
1/4	62	72	77	80	82	82	82	81	80	77	73

Table V.

for tangential wheels are obtained with pitch diameters from 10 to 30 times the jet diameter. Efficiencies that should be obtained and the corresponding specific speeds are given in the accompanying table V and the efficiencies are further plotted in Fig. 25.

PREVENTION OF ELECTRICAL MINE ACCIDENTS.

The problem of safeguarding electrical mine equipment is discussed by H. H. Clark in Technical Paper No. 19 from the Bureau of Mines. There is no general formula or equation for its solution. Moreover, there are so many variables involved, so many factors that cannot be exactly related, so many possible coincidences, that results cannot be predicted with mathematical exactness. It is necessary to consider each part of the problem by itself, in the light of local conditions, and to adopt such measures as insure a large factor of safety.

Scanty light, limited space, and the presence of dust and dampness are underground conditions that are favorable to the occurrence of electrical accidents. The influence of the first of these may be eliminated by providing lights at particularly dangerous places, such as partings and crossovers. If electric wires are a source of danger at such places, they can be made a source of light also.

Although it may be impracticable to eliminate entirely the effect of limited space, this condition may be counteracted by the erection of guards about apparatus.

Dust and dampness are elements that can hardly be separated from the operation of a mine; in fact, the presence of dampness is often desirable to offset the effect of dust. It is possible, however, to provide apparatus so designed and installed as to resist the action of dust and dampness, and the more generous the factor of safety included in such design and installation the greater will be the resistance.

The problem of safeguarding may be divested of some of its vagueness and put in concrete form by considering that if the electric current can be kept where it belongs—in the conductors designed to carry it—it cannot give shocks, set fires, or ignite gas, dust, or explosives. Electricity becomes actively dangerous only when it breaks away from its proper channels in stray currents or as sparks and arcs.

It must be admitted that the electric current cannot be kept where it belongs in the sense of eliminating entirely such sparks and arcs as occur at fuses, circuit breakers, air-break switches, starting rheostats, and the commutators of direct-current machines. In this connection the factor of safety must be applied by arranging to confine the outbursts of current to a limited area unoccupied by anything which may be affected by heat or fire.

Assuming that in the selection and installation of electric equipment care has been exercised to insure the proper confinement of the current, the factor of safety may be increased by grounding the dead metallic parts of apparatus, by providing means for insulating the bodies of those who work upon such apparatus, and by barring from the vicinity of the current such elements as are explosive or combustible.

PHOTOGRAPHY IN ENGINEERING

BY M. R. LOTT.

Intensifying Solution.

This solution is used when a plate has been insufficiently developed or when it is too thin for satisfactory printing. The hypo must be thoroughly removed otherwise yellow stains will result.

A solution prepared as follows: 1¼ ounces of potassium iodide and 6 ounces of water has added to it, a concentrated solution of bichloride of mercury until the red precipitate which forms will no longer dissolve by shaking, being careful to add only enough of the bichloride solution to make it only slightly turbid. To this is added 1 ounce of hypo, which is dissolved and enough water added to make 20 oz. of solution.

To use add three parts of water to one part of the solution. Care should be taken not to overintensify but should such a thing happen the plate may again be reduced by placing it in the hypo bath for a short time.

Reducing Solution.

This solution is used in case the negative is too dense to print well, and is prepared as follows:

Dissolve 1 part Red Prussiate of Potash in 15 parts of water and place the solution in a bottle wrapped with yellow paper to guard against decomposition by light.

To a solution of 1 oz. hypo in 15 oz. water, add ½ to 1 oz. of the Red Prussiate solution immediately before use.

A negative may be reduced immediately after fixing, a plate already dried should be soaked in water a short time before being treated.

Reduction should take place in subdued light.

The above solution may also be used for reducing over-developed Velox prints though potassium cyanide usually gives better results. When potassium cyanide is used it may be either as a solution or a cake of it may be rubbed directly on the print itself. As potassium cyanide is extremely poisonous care must be observed in its use.

Eastman's M. Q. Developer.

This developer is designed especially for Velox prints and gives very good results. The stock solution should be placed in small bottles as it keeps better in small quantities. Should trouble be experienced in keeping the hydrochinon in solution the trouble may be eliminated by adding 13 ounces of wood alcohol to the stock solution mixed in the quantities given below. Wood alcohol must be used instead of the denatured as the latter does not accomplish the desired result.

Mix in the order named.
Dissolve in 100 ounces of hot water

Metol	½ oz.
Hydrochinon	2 oz.
Sulphite of Soda (dessicated)	7½ oz.
Carbonate of Soda (dessicated)	10½ oz.
Potassium Bromide	¼ oz.

To use dilute with water
1—4 for Special Velox
1—2 for Regular Velox
1—6 for Eastman's Bromide Paper

Non-abrasion may be secured by adding 10 grains of potassium iodide to each ounce of the stock solution. This also gives a yellow cast to a print the color disappearing when fixing is complete.

FIXING AND HARDENING SOLUTION.

Water	64 oz.
Hypo	16 oz.

To which is added the hardening solution prepared as follows:

Water	5 oz.
Sulphite of Soda (dessicated)	½ oz.
Acetic Acid No. 8 (containing 25% pure acid)	3 oz.
Powdered Alum	1 oz.

EASTMAN'S BROMIDE PAPER. DEVELOPER.

Use the M. Q. Stock solution diluted 1—6.

FIXING SOLUTION.

Hypo	3 oz.
Water	16 oz.

FOR SEPIA TONES.

Sepia tones sometimes impart a richness to Bromide enlargements which are very pleasing. The print to be treated is first placed in a bleaching solution until only faint traces of the half-tones are left, then rinsed in clear water and placed in the re-developer until the original detail returns.

The Eastman Kodak Company gives the following formulas:

1. BLEACHING SOLUTION.

Ferricyanide of Potassium	5 oz.
Bromide of Potassium	6 oz.
Water	120 oz.

2. REDEVELOPING SOLUTION.

Sulphide (not sulphite) of Soda	5 oz.
Water	60 oz.

To use
Prepare Bleaching Bath as follows:

Solution 1	4 oz.
Water	4 oz.
Aqua Ammonia	4 drops

Prepare Redeveloper as follows:

Solution 2	1 oz.
Water	8 oz.

Properties of Chemicals.

The chemicals used in the preceeding formulas have the following properties:

Alum. A white substance used in fixing solutions for paper and negatives to harden the gelatine film.

Bichloride of Mercury. A white compound, highly poisonous, used in intensifying solutions to blacken a weak negative.

Bromide of Potassium. A whitish crystalline substance used in a developer as a restrainer to counteract the effects of over-exposure, restraining the development of the shadows thereby increasing contrast.

Carbonate of Potassium. A whitish compound used in a developer to give the alkalinity required for action.

Carbonate of Soda. A whitish powder used in developers as an alkali, its action being similar to that of potassium carbonate, six parts of carbonate of soda being equivalent to three parts of potassium carbonate.

Chrome Alum. A purplish powder used as a hardener in fixing solutions.

Cyanide of Potassium. A white poisonous compound used to remove stains and to bleach prints.

Ferricyanide of Potassium. A red crystalline substance, also known as Red Prussiate, used as a reducing agent for negatives and prints.

Hydrochinon. A yellowish white substance coming in the form of needle like crystals. Used as a developing agent.

Hypo. Thiosulphate of Sodium. A white crystalline substance used as a fixer for negatives and prints.

Metol. A grayish powder used as a developing agent.

Oxallic Acid. Whitish crystals, used as a preservative in Pyro developing solutions.

Pyrogallic Acid. A white substance used as a developing agent.

Sulphite of Soda. A white compound. Used as a preservative in alkaline developers. It must be kept tightly sealed from the decomposing action of the air.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

CONTRACTORS' CONVENTION.

The third annual convention of the California State Electrical Contractors' Association was held at San Jose, July 24-27, 1912. Wednesday and Thursday were devoted to routine business discussions between the members, the ladies and guests being entertained by automobile trips. Thursday's meeting was held at Palo Alto with a theatre party in the evening.

Friday's meetings were open to all with a large attendance of representatives from central stations, jobbers and manufacturers. H. V. MacMeaus described the workings of the compensation plan of the Roseberry employers liability law. Milton Wise read a paper on Advertising, W. S. Hanbridge spoke on Estimating, C. W. Mitchell on the Underwriter's Rules, T. E. Bibbins on the Relations between the Manufacturer and the Contractor, C. C. Hillis on the Relations Between the Jobber and Contractor, and A. H. Elliott on Co-operation. These papers will appear in this and subsequent issues of the Journal. Geo. C. Holberton described the system of the Pacific Gas & Electric Company, illustrating his talk with a large number of lantern slides.

The election of officers resulted in the re-election of John G. Rendler as president, J. S. Reynolds as vice-president, W. S. Hanbridge as secretary-treasurer, and Robert Booth as sergeant-at-arms. C. V. Schneider was also elected vice-president.

The various electrical inspectors present formed a state association which will be affiliated with the national organization.

The annual banquet on Friday evening was a most brilliant affair and greatly enjoyed by all present. Dancing concluded the evening's entertainment.

Saturday was devoted to the Electrical Trades' picnic, a crowd from San Francisco joining forces with the delegates. In the morning a baseball game was played between the northern and the southern contractors, the former winning by the score of 12 to 6. After an enjoyable picnic lunch there were a large number of amusing races for prizes and later a baseball game between the Jobbers and Contractors, the former winning by the score of 20 to 11, score cards being presented by the Stewart-Fuller Company.

SONS OF JOVE REJUVENATION.

A Rejuvenation of the Sons of Jove was the crowning event of the convention on Saturday evening. A class of 42 were initiated into the order under most favorable auspices by the San Francisco members. The degree team consisted of A. E. Drendell, Jupiter; E. B. Strong, Neptune; M. L. Scobie, Pluto; T. E. Bibbins, Vulcan; John R. Cole, Hercules; Arthur H. Halloran, Mars; G. I. Kinney, Apollo, Fred Poss, Avrenim, and W. W. Hanscom, Mercury, ably assisted by half a dozen imps.

The candidates were as follows:

Anderson, P. A.	Fisher, R. E.	Markham, Monroe
Arbogast, G. E.	Fuller, A. R.	McNally, W. A.
Battee, Geo. H.	Fulton, Alex.	Miller, H. L.
Belden, Geo. F., Jr.	Gallivan, D. G.	Newbert, Lee H.
Booth, R. L.	Hand, E. D.	Parsons, T. H.
Britton, J. A.	Hemington, W. A.	Phillips, M. W.
Bullard, A. W.	Hixson, M. C.	Skoog, Sidney P.
Burkhart, E. F.	Holberton, Geo. C.	St. John, T.
Butte, C. F.	Hook, R. W.	Tardif, W. J.
Capps, I. L.	Hope, N. M.	Thompson, A. V.
Cohn, Seth	Hyler, A. M.	Vander Naillen, R. L.
Davis, G. W.	Kohlwey, W. D.	Watts, Frank W.
Dougall, R. B.	Levy, Phil	Wise, Milton E.
Eppstein, Clarence	Liebes, A. J.	Yost, W. F.

This convention was the most successful yet held. Many vexing questions were amicably settled, new acquaintances were made and old ones renewed, and a most profitable session resulting to all concerned. There is a strong likelihood of the early formation of a Pacific Coast organization which will include the contractors of Washington, Oregon and California.

HOW THE MANUFACTURER AND CONTRACTOR CAN ASSIST EACH OTHER IN THE GENERAL UPBUILDING OF THE ELECTRICAL BUSINESS.

BY T. E. BIBBINS.

I was requested to talk on the subject "What the contractor should do to assist in developing the manufacturer's business." The subject as outlined does not meet with my views of co-operation, and therefore I took the liberty of making the suggestion to your committee, which was accepted, that the subject be made "How the manufacturer and contractor can assist each other in the general upbuilding of the electrical business." All this might be summed up in the very familiar term "Co-operation."

When we look back over the past, those who are older in the business will recall the time when the contractor hardly spoke to his fellow, because of jealousies and lack of understanding. Unquestionably this was also so, among the jobbers and among the manufacturers. Personally, I hold to the view that the better one knows his competitors, the easier his path, and in the end the business of the whole, as well as of one's company, is promoted. I have always felt that this was the line of procedure, from a commercial, as well as a personal standpoint, and it will apply to the contractor in his relations to his brother contractor, and also in his relations to the manufacturer. Right here let me say that your association is right in line with this idea.

The contractor has unquestionably a very important position in the electrical world. The manufacturer has found by experience, and costly at that, that he cannot manufacture and do contracting at the same time. He must abandon one or the other. I can well recall the time when one of the large manufacturers not only made its apparatus and supplies, but attempted to do wiring of buildings. Some of you will recall that they wired the old Chronicle Building, and the Mills Building in San Francisco. Station wiring and general construction which had to do with the electrical equipment was done by the manufacturer. The policy today of the manufacturer is to leave this to those who know how to do it economically and well. Unquestionably this is an age of specialists, and specialists can be contractors, and contractors should be specialists.

Where there is competition, naturally there will come misunderstandings and friction. Where the manufacturer comes into competition with the contractor, it can be expected that this same misunderstanding and friction will occur. Here is an opportunity to apply our subject. We have got to be broad-minded in our relations to each other, and recognize these competitive conditions that may come about, in a manful way. Obviously it is poor policy to lose our heads here, and in retaliation strike a fatal blow; but rather let us be patient with each other.

For the contractors to consider that they are body unto themselves is a mistake, for there are four parts or branches to the body—the electrical contractor, the electrical dealer, be he retailer or wholesaler, the seller of electric current, and the electrical manufacturer. No one of these four branches of the complete body can be attacked without harm being done to the other. With full knowledge of the fact, can you afford to attack another part of the body? When one part lacks prosperity, the others suffer in like extent. Therefore it is to your own interest to assist in the healthy upbuilding of the others, and believe me, in this you build for yourself. You should not make light of your ability to help here. The effect will be far-reaching if, at the right time, each one of you should say the right and kindly word of the power company, the jobber and the manufacturer, and in more material ways assist each along the way to prosperity. Let us forget

for all time how to knock—let us boosters be. Let us feel the dignity and largeness of our position, and live up to it.

It seems that the other three parts of the electrical body should strengthen the contractor's hands. Wherever it is possible, on economic lines, to increase his profit, it should be done, and I am distinctly in favor of it. Wherein the contractor has a definite place, i.e., wherein a contractor is the logical one to do the work, I believe that he should be given the work to do, and in this, I am not attempting to use generalities.

For instance, I believe that the contractors of San Francisco should be aided in every way along legitimate lines to handle the vast amount of electrical wiring, etc., and other kinds of installations in the preparations for the Panama-Pacific Exposition. Instead of aiding and fostering the great number of "fly-by-night" contractors who will unquestionably come into this territory, and leave behind them when they go, a stack of debts, which in the economy of things we—most of us—must pay, I believe that we should support our own contractors. It seems that here is a practical application for the Electrical Development League. Possibly that body might express itself in firm tones that our friends at home should be recognized above those concerns who arise over night, and disappear with equal suddenness.

Right here a word of caution:—if your friends in the labor union consider it a time to reap a large harvest in the way of unusual charges for their labor—if the supply men should consider it the time to exact unusual profits, or if the contractor himself decides that he will take the business only on very profitable lines, then surely you can predict that the outsider will see his chance, and will be quick to take advantage of it.

Have you ever considered the possibilities of building up a contracting business based on a reputation for quality of material and workmanship, reliability, etc., as against the business built up purely on the lowest price? The contractor who will establish as his basis of doing business a good reputation, will need to employ salesmen instead of pencil-sharpeners, but in the end, he will have a business to be envied. For this man to succeed, he must bring scientific management into play; he cannot disregard one opportunity for economy. I cannot conceive that the contracting business should differ in respect of rewards for brain effort in such management, from the usual run of business.

Certain of the manufacturers employ engineering corps for the devising of new articles for your use, and for the improvement of the older devices, and the tendency is towards a better article at a cheaper price. The desire of the Fire Underwriters is to encourage the manufacture and use of better class of material; the municipal inspection services are tending that way.

Unconsciously, I believe the average contractor labors in the direction of cheaper and not better material, as being a means to secure the job at a lower price. I doubt if such a position in the long run is wise, or accomplishes this result, for the reason that it tends to depreciate the industry, rather than to uplift it. Has not the time come when your organization should carefully consider this feature, with the idea of building up, rather than tearing down? Your body should make it one of its prime principles. The wise contractor will endeavor to assist the manufacturer with the architect, in securing the adoption of the highest class of material available. The burden of education of the architect and builder should rest equally with the contractor and manufacturer.

Here is another application for the subject of this talk. Boost for the highest grade product. This plea is not solely in the interest of the company which I represent, but in the interest of the entire electrical industry.

Finally, with a full idea of your self-interest, the manufacturer and contractor can best assist each other by good team work; by the elimination of petty jealousies; by a full recognition of the contractor on the part of the manufacturer; in turn, by a breadth of mind on the part of the contractor towards the other portions of the electrical industry; a united effort for reasonable profits; the constant effort in the direction of proper understanding of each other's position in the electrical field; and the eternal forbearance towards the other fellow.

THE EVILS OF THE CONTRACTING BUSINESS AND HOW TO CORRECT THEM FROM THE EYES OF A JOBBER.

BY C. C. HILLIS.

The fundamental principles underlying the conduct of a successful electrical contracting business are no different than they are in any other branch of the industry. In my judgment there are three important requisites in carrying on any business, and they are: Firstly, knowledge of the business; Secondly, sufficient capital; Thirdly, honesty of purpose.

Perhaps in the electrical contracting business the question of capital should come third, as I believe it is possible to do a successful business of moderate size with limited capital, but the other two requirements are absolutely essential.

A person engaging in the electrical contracting business should certainly be equipped with sufficient knowledge of the business to enable him to handle any engineering problems that confront him in estimating jobs, and should have the ability to attend to the proper installation of the material so that in bringing the contract to final completion the work will be done in a first class manner and with the least possible waste.

If he would build for permanency, he should have the highest aims for the conduct of his business, treating his customers fairly as well as keeping in mind constantly that the class of work which he does should be of such order, that it will always stand to his credit in the future.

From the observation of twenty years spent in the electrical business I have seen many evils in the electrical contracting business, some of which are:

An inadequate system of bookkeeping, with an inaccurate record of material used on jobs and job costs;

Insufficient energy in collection of money due, and coupled with this, the fault of too freely granting credit on material sold, or not proper care taken to insure collection of money for work done where dealing with people of hazardous credit;

An inclination to overstock on material, and purchasing material of poor grade because the price is attractive.

Too freely distributing purchases;

Not sufficient effort made to inspire the confidence of your supplier;

Too many engaged in the business for the amount of work to be done;

No stability in prices for doing a particular kind of work.

In regard to the keeping of account books and other records, it is needless for me to say that no business that is growing can be handled successfully without an accurate system of bookkeeping. The number of books necessary to keep accounts straight, of course, will vary according to the size of the business, but the smallest business should have at least a double entry ledger, a cash book, and a day book or journal. With these books they will be able to draw off a trial balance at the end of each month and thus give them some idea of their condition. Some time ago the Electric Appliance Company sent to all of the contracting firms on its trade list a copy of a little book entitled "Bookkeeping for the Electrical Contractor," and I believe we have a few of these left and will be glad to send a copy to any contractor who has not already received one, if they will write in for it. When beginning a job, an account should be opened in the ledger with the particular job, and all the material that is sent out on the job should be charged against it; and any material returned during work on the job, or material re-

turned unused when job is completed, should be credited. All labor and other expenses, in the way of carfare, drayage, etc., should be charged against the job, so that when the job is finally brought to completion the contractor will be in position to tell to a cent what the job cost him to complete, and in this way will be enabled to figure how near he came to the amount of his contract. Every contract taken should stand on its own bottom, and not try to make the profits from one job help to carry the loss on some other job taken at a figure below what it should be.

A fault which is prevalent among a great many contractors is, that they are poor collectors and poor credit men. I do not believe this fault is caused in a great many cases through lack of ability, but it seems to be principally due to the fact that they fear to jeopardize their trade by asking their customers for money. If you would go over the books of any jobbing house you would find that the largest percentage of contract customers are slow pay, principally on this account. The conducting of any business is a serious proposition, and no debtor should be offended when he is asked for settlement on money that is past due. If the contractor does not keep his collections up, in most cases he is not able to pay his supplier, and many times this will cause a lack of confidence to spring up, which frequently could be avoided.

A contractor when doing work should, at all times, see to it that his interests are protected, and where a job calls for work with someone of hazardous credit it should be his business to protect his interests either by guarantee or such other arrangements for settlement as will insure the collection of the account when it is due.

The question of stock is a serious one with the contractor, as it is also with the jobber, and the greatest care should be exercised in the purchase of material. Even though the material purchased might be entirely standard, it is, in my judgment, poor policy for a contractor to buy beyond his requirements of a period of sixty or ninety days at the outside, as to do so would be liable to tie him up on finances, which may be more or less burdensome. I also believe it is poor policy for a contractor to buy material which is not of the highest quality, simply because there is an attractive price attached to it, and then work such material off where it is convenient to do so. The using of any material that is not high grade, simply lowers the standard of the job as a whole and is bound to reflect on the contractor sooner or later, and anyone engaged in the business and expecting to stay in the business and develop it, will find that it pays to have the reputation of doing first class work with no come backs.

I also believe that the contractor should not too freely distribute his purchases. I consider it better policy for him to confine his purchases on all staple lines to three or four suppliers at the most. This is particularly true for the small contractor, who at times will need additional credit beyond what he ordinarily enjoys to carry on some particular job he has in hand, and this plan will also serve to make his business worth while to his supplier who will then have enough interest in the account to see that his customer is kept informed on market changes and give him such other information as will protect him on jobs in hand or prospective.

While on this question of relation between contractor and his supplier, I believe in many instances there is not sufficient effort made by the contractor to inspire the confidence in the mind of the jobber there should be. To get the best results, there should be a mutual confidence between the jobber and the contractor. The jobber on his part should supply first class material at the right price and should give the best of service in the way of prompt shipment, etc. The contractor, on his side, should make it a rule to answer all correspondence promptly and make such effort as is necessary to maintain the full confidence of his supplier. The question of answering correspondence promptly is particularly important where the same refers to the question of accounts. If the contractor finds that he is not in position to meet an account which is due, he will increase the confidence of the supplier many per cent if he will take the initiative in writing a letter of explanation of his inability to pay the account, making at the same time some definite promise if possible which should always be kept. The credit man of any supply organization has a tender spot in his heart for buyers who look after their affairs in this way, and many times you will find the customers he considers most profitable and satisfactory are the ones that look after these details.

There are also too many contractors engaged in the business for the amount of work to be done. How to overcome this difficulty, however, is something I am not able to suggest at this time. There are some of them in the business who have not all of the requirements I previously mentioned, in the way of experience, capital or honesty of purpose. Perhaps some of them have not any one of these requirements, but in such cases they only make a flash in the pan and then are extinguished, but during the time they are in business they serve to make it hard for the legitimate contractor who has the ability and determination to carry on his business successfully.

The contracting business at best is a hazardous one, as there are so many elements entering into its success or failure. Looking at it from an economical standpoint, the contractor's business is the least profitable of any which the electrical supply jobber has on his books. They always enjoy a price which shows a very small margin of profit over the jobbers' cost, and at a profit which is usually way below the jobbers' percentage of operating expense. From the standpoint of credit risk, statistics show that the percentage of loss is at least ten times greater than with any other class of customers which the jobber sells, and I believe that the books of most jobbers will indicate their ratio of loss of accounts on contract customers will average at least two and one-half per cent of their gross sales. This condition is undoubtedly brought about through the fact that many of the losses occur through contractors starting in business without the knowledge or experience necessary to handle the business successfully.

I believe that the contractor is much better off when there is a stability of price on any class of material he purchases from the jobber, and it should be to the contractors' interest to encourage stability of prices rather than by looking for inside prices on material which he buys.

If it was possible to have stability of price among the contractors for doing work of a particular kind, it would be most desirable. This is perhaps a difficult proposition to bring about, but if the cost of material purchased by the contractor was the same as his competitor and his cost of labor doing a particular kind of work was the same, it would seem that there should not be a very wide difference between the figures on any ordinary sized job. The contractor who has the backbone to insist that on all bids he makes he must show a reasonable profit beyond expenses, and will only accept contracts that show a profit, will be in the game long after his competitor who does not keep profits in mind will have passed to the down and out graveyard.

In his working force on a job he should give a great deal of attention to the selection of his men, and while he has to pay the board price for services, his chance of profit on the contract lies largely in the class of workmen he has on the job. It is easy to figure what a good man should reasonably do in a given time, but what he will actually do may vary from his figures many per cent and turn an otherwise profitable job into a loss. There is a better chance for making profit by watching this part of the business closely than there might be on any difference in price in the purchase of material.

There is unquestionably a mutuality of interests between the jobber and the contractor. It is to the jobbers' interests to see the contractor succeed, and he will undoubtedly do what he can to further the interests of the contractor and make his business a success. On the other hand, the contractor should do his part looking toward this end. They should both work for harmony between the two interests.

I would like to say a word in regard to associations of this kind and mention some of the benefits that are to be derived from it.

Thinking men have come to the realization that a great portion of their time is given over to their business, and they also realize they can accomplish much more good for themselves by cultivating the acquaintance of their competitor than they can by fighting him. Business has expanded to such an extent that we are no longer able to keep to ourselves; we often need the help of the other fellow.

It is my belief that the means of education that an association like yours affords, have more to do with the success of your business than you would be willing to grant on first thought.

The most powerful agency in the development of man is his association with his fellow man. It not only develops his mind but has a great influence in the formation of his character. It creates ideas and instills within him the inspiration to put his ideas to the proper use.

When we go to school we acquire a certain amount of education, but the best school of all is the school of experience. There is no theory there; it is actual practice. So it is with an association of men engaged in the same line of business. If we only have a speaking acquaintance with ourselves, we are still working along in the elementary grades. When we come together in association work, we are getting out into the broader channels of trade where we really can and do develop what is in us, where we develop into men who are big enough to see that to be successful ourselves we must lay aside all that is mean and narrow and petty and understand that if this world is big enough for us, it must also be big enough for the other fellow.

Most men of affairs have many talents but they excel in but few. We have our gifted orators who have the faculty of saying fine things at the right time but that orator to get the proper inspiration must have a good listener. So it is in the conduct of business. We must have our good talkers the quiet, unassuming fellow who says little but thinks much, and he is the one who often has to act as the brake and keep the ship of commerce steered in the proper course.
who talk intelligently and tactfully but we must also have

You may look around you or run over in your mind the friends or acquaintances you know, and when you see a man who has made much success, it is done through his close contact with his fellow man.

Some one man may have a good idea but there is usually some other man who has a better one. By combining the two good ideas, however, some plan of operation can be mapped out which is usually the most successful.

It is impossible for a man to associate with a group of men with high aims and a strong sense of right and wrong without absorbing some of the good himself; hence it follows that the man whose methods have been questionable can be educated to become a good worker in the common cause of all when inside the association.

Any association or organization to live and succeed must be founded upon right lines and on principles which do not benefit a few but which will show some returns to its smallest or weakest member. It is logical to expect that in the conduct of an organization that is successful, it must be handled by men who work hard and unselfishly with the idea that what is good for others must also be good for them. They cannot look at things through their own eyes alone but must look at matters in such a way as to meet the approval of their fellow members. A position of this kind cannot be handled successfully by one who is too narrow or who has not the confidence of his associates. Work of this kind not only gives a man a better insight into human nature but his mind unconsciously expands and you soon find that men who formerly were bitter competitors are able to sit down and talk over matters of business which concern them both without the suspicion in their minds that the other fellow is going to betray his confidence.

Perhaps no one thing keeps the average man on the path of righteousness more than the fear of losing the respect of his fellow man. The closer men come in contact with each other the more careful they will be that their acts may be above suspicion. No man will have his faults aired and discussed without trying to correct those faults.

In all bodies of men there are bound to be some backsliders but in time these delinquents will naturally find themselves changing their coat of many colors to one which is more pleasing to the eye.

May we not hope to look forward to the time when all of us will conduct our business, constantly bearing in mind the obligation we owe one another?

DEVELOPMENT OF THE ELECTRICAL BUSINESS BY ADVERTISING.

BY MILTON WISE.

No matter what enthusiastic advertising men may tell you, advertising is not a science and it does not seem to me that it will ever be a science. They speak nowadays of the science of salesmanship and we all know that there are certain laws that govern the art of selling goods. But there are no set of rules that, followed implicitly, will sell a certain kind of goods to all kinds and types of people. Advertising is merely another form of salesmanship and until the laws that govern salesmanship are absolutely fixed there can be no exact science of advertising.

Advertising is accomplishing such wonderful sales results that we are likely to gain an exaggerated idea of its value. If we could peek behind the scenes at some of the great advertising successes, we would see the vast amount of time, care, intelligence and money that has helped the publicity. We would realize that salesmanship, distribution window displays and persistency have been important factors in making these campaigns successful. And we would realize that merely buying space in newspapers and magazines and street cars or on billboards, and filling this space with pleasant words and attractive pictures, do not constitute real advertising.

There can be no doubt as to the value of co-operative advertising in developing the electrical business. We who are in the electrical business on this coast—whether we be contractors or manufacturers or central station men—are confronted with a stupendous opportunity.

Co-operative advertising will help all of us in realizing our possibilities, because co-operative action will bring us together and keep us together. Instead of fighting among ourselves, we will fight, shoulder to shoulder, for one big, all-absorbing purpose.

I do not think that co-operative advertising must always be co-operative in a physical sense. When the electrical interests individually advertise their businesses in an intelligent manner it must impress the public with the value of electrical appliances and of electricity. My definition of co-operative advertising is not necessarily an advertisement that carries as its signature the names of all the concerns engages in the electrical business or the name of an association organized for the promotion of the electrical industry. Wherever the spirit of co-operation is alive and wideawake and wherever this spirit is manifested in two or a dozen individual advertisements, either in the newspapers or the

billboards or the street cars, you have a real co-operative situation.

The problems that confront the co-operative advertising campaign are exactly the same as those that confront the individual advertising campaign. Perhaps it is more difficult to conduct a co-operative advertising campaign because there are so many different kinds of people with different ideas to please that it is difficult to keep the advertising enthusiasm up to the high pitch necessary for advertising success. I don't think that co-operative advertising alone will greatly develop the electrical business unless there is a cordial understanding among all of the various electrical interests. If the contractors or the central stations are doing something that is against the business interests of the industry, from a broad point of view, then all of the co-operative advertising in the world will be a dismal failure.

The best kind of advertising for the electrical business is electrical advertising. Surely the fact that we are willing and anxious to take our own medicine will help convince other people that they should try a little out of the same bottle. A large electric sign advertising a central station or an electrical contractor will do more good than twice the expenditure put into newspapers or street cars or billboards. I am not decrying any advertising mediums. They all have their particular fields. But you will notice that the newspapers and the street cars use first of all their own medium through which to advertise their own business.

Advertising pays in proportion to the care and intelligence exercised in planning and executing the campaign. It takes time and money and a certain degree of intelligence to build advertising that is different and yet not freakish, that carries to the public mind some definite idea. In this day when we are surrounded by so many distractions, when we have so many editions of the daily newspapers and are kept so busy dodging automobiles, it needs a keen mind to plan an advertisement that will reach out, take the casual observer gently by the lapel, turn him face about, and, briefly, concisely and interestingly tell him a merchandising story.

The first influence of co-operative advertising is a moral one. It makes all of us feel as though we were engaged in a great mission. It stiffens our backbones and makes us carry our heads higher.

But before we advertise our virtues let us be sure of them. Let us get together, as we are doing now, to straighten the kinks in our mutual relations, and to create a smooth, sweet running machine.

Then let us plan and execute our co-operative advertising.

THE UNDERWRITERS' RULES.

BY C. W. MITCHELL.

Of the many known causes of fires of which we read daily, there is one in particular in which the members of this Association are interested, and that is electricity. I will admit that many of the fires whose causes are attributed to "crossed wires" are not started by electricity, but yet there are a sufficient number due to that cause to justify municipalities and underwriters maintaining electrical inspection departments.

The hazard of electricity was recognized early in the progress of the electrical industry. On October 19, 1881, the New York Board of Fire Underwriters gave notice that in all buildings in which uncovered electric light wires, or in which arc lights with open bottoms or without globes are found, the wires must be covered, and the lamps altered to conform to the rules of this Board, "and in case the alterations are not made within said time the insurance on said property will be cancelled."

In the early part of 1892, through the initiative of Mr. C. M. Goddard, Secretary of the New England Insurance Exchange, rules were prepared by representatives from various Underwriting Boards in the New England, Middle, South Atlantic and the Gulf States. Out of this grew the Electrical Committee of the Underwriters' National Electrical Association.

In 1897 there was held the first national conference of delegates from various societies and the first edition of the National Electrical Code was issued. The preparation of these rules, however, devolved upon representatives of underwriting organizations. From that time until 1911 the rules were issued in odd years under the direction of the Electrical Committee of the Underwriters' National Electrical Association. The 1911 edition of the Code was prepared by a committee from the National Fire Protection Association. It was decided to turn this work over to the association because it has for its active members National Associations other than underwriting organizations and prepared other standards as regards fire protection and fire prevention.

Of all the rules of the Code the ones which probably concern most the members of this Association are those for "Inside Work." Under this heading are included all of the rules for wiring, for light, heat and power. They do not include the rules for signaling systems, such as telephone, telegraph and fire alarm systems as these circuits are not in themselves hazardous, and become so only through being crossed with light, heat or power wires or on account of lighting discharges.

The present methods of inside wiring are the result of a "cut and try" practice for the past 20 years. Originally wood was considered a sufficiently good insulator and many devices such as cleats and parts of cut-outs, switches, sockets, etc., were made of this material. These wooden fittings and devices have been gradually eliminated, until at the present time nothing but marble, slate, porcelain and certain kinds of composition fittings are permitted. The rules have been gradually extended to take into account the new forms of construction and appliances which have been developed during these years.

In most of the larger structures, such as office buildings, theatres, etc., the electrical installations are planned at the time the general plans of the buildings are drawn. The load in the building, the method of distribution and the running of the wires are completely arranged in order that there may be the greatest efficiency and economy. But this is not always the case with the larger buildings and quite frequently no provision whatever is made in the plans for the electrical equipments in the smaller ones. Many a time have I heard the electrician complain that the architect seemed to think no space was required for the installation of electrical apparatus and yet he didn't want any of the work exposed or would not allow any marring of the "architectural beauty" of the structure. So, between the architect and the inspector the poor electrician has a hard time of it. Oftentimes the electrical work in a building is an afterthought altogether and quite frequently the contract is given to the lowest bidder regardless of the class of work that he does.

However, in spite of all the drawbacks, the general tendency is for an improvement of all electrical installations and a stricter adherence to the requirements of the Code. Although the Code rules may not be perfect, the collection is the best we have, and is the result of years of work of trained and experienced men. Some of the rules have at times been interpreted differently by different men. We are, however, through inspectors' associations and public discussions, making strides toward uniform interpretations. The inspector interprets the rules; he does not make them. And as the honest contractor is guided by the same rules there should be no discord between contractor and inspector. Both should work to the same end, viz.: to establish the National Electrical Code as a uniform standard for all electrical work.

It is thus apparent that the labeled devices, with rare exceptions, are the best of their kind that may be obtained and the contractor who wishes to install only first class work will insist upon having only labeled devices when such devices are included in the label service.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

A Course in Gas Engineering

The Pacific Coast Gas Association last year enthusiastically assembled in convention at Oakland and declared in favor of establishing a chair in Gas Engineering at the University of California. This declaration was not in words alone, for the association is making good its declaration to the extent of $30,000.

The growth in wealth of crude petroleum in California has brought untold riches not alone to the fortunate owners of productive oil wells, but to practically every industry and fireside in the state. The influence of cheap fuel has brightened commercial activity and family life alike. In the industries, hitherto unproductive, high cost of fuel made many classes of manufacturing impossible. In the home life the high cost of cooking and illuminating gas often made life a drudgery. The dirty but happy-faced oil derrick has, however, changed the situation wonderfully. Abundance of oil mixed with a properly sprinkled application of Western brains have brought forth oil gas, which for illuminating and cooking qualities to say nothing of the low cost of domestic supply could hardly have been in the fondest dream of western gas men fifteen years ago.

So rapid has been the advent of oil gas manufacture and so few those prepared to technically enter this productive field, that the present outlook for a successful career in gas engineering, if the young engineer be properly trained, is perhaps more flattering than any of the kindred professions.

The proposal on the part of the Pacific Coast Gas Association to maintain a chair in gas engineering at the State University merits the heartiest commendation. New opportunities, new fields for investigation and finally improved methods in gas manufacture are sure to result.

At the forthcoming convention of the Association in San Diego, the subject of what an ideal course in gas engineering should consist will be brought up for discussion. The outcome will be watched with much interest. Meanwhile the splendid spirit shown by the Pacific Coast Gas Association in thus materially incouraging educational instruction looking toward gas manufacture is receiving the hearty commendation of all.

Pronounced Firmness of Western Utility Securities

Reports from Western public utility companies covering the first five months of 1912 are indeed gratifying. The Southern California Edison Company shows gross earnings of $1,741,441 with net earnings of $843,019 and a surplus fund of $542,300. The Portland Railway, Light & Power Company shows earnings of 5.5 per cent on its $25,000,000 stock. The Pacific Gas & Electric Company, comprising the greatest hydroelectric distribution system in the world, shows gross earnings of $6,277,512; expenses, including taxes and reserves

$3,428,815; net earnings, $2,848,697; bond and other interest, $1,420,643; net income, $1,428,054; bond discount and expense, $41,552; preferred stock dividends, $300,000; common stock dividends, $365,169; surplus for depreciation and other purposes, $721,333.

During the five-months' period covered by the above statement of the Pacific Gas & Electric Company, this enterprising corporation has gained 8300 new consumers. Gas sales, as compared with the same period of 1911, increased more than 245,000,000 cubic ft. and at the present rate will exceed those for 1911 by 600,000,000 cubic feet. The electrical business of the company is also growing at a most satisfactory rate. Contracts for more than 10,000 horsepower were signed up in the six weeks since May 31st, or at a rate of 1600 horsepower a week. This growth was well distributed over the entire system, the average of these contracts being about forty-five horsepower each. Should such a rate of growth continue, it is not unreasonable to see a complete market for all available hydroelectric power supply in the great State of California within the next twenty-five years

The attitude of Eastern money markets toward Western hydroelectric securities is more encouraging. The common stock of the Pacific Gas & Electric Company, according to the Financial World of New York, was recently lifted out of its rut and was boosted from 61 to 66 in 24 hours. The investors who bought this stock around the high prices of the year have held on tenaciously and this has made the stock scarce.

Again, according to the same authority, a Boston-New York banking syndicate, which a year or more ago underwrote $3,000,000 of the 5 per cent bonds of the Great Western Power Company, is reported to have sold the last of these bonds to the amount of about $1,000,000 to London bankers. At the same time the syndicate is said to have taken up $2,000,000 of the bonds held by New York bankers as security for a note issue and to have been buying up the floating supply of these bonds on the local markets. The result has been that the bonds have moved up from around 87 to 88¾. At the same time both the common and preferred stocks of the Western Power Company, the holding company, have suddenly broken away from the dull state into which they have been for months and speculators have been buying the preferred stock especially in the expectation probably of an early declaration of a dividend. About 1000 shares or more have changed hands daily lately.

All this activity in the securities of this rival of the Pacific Gas & Electric Company means, it is believed, the early consummation of plans for the development of 60,000 additional horsepower from the company's California water power properties not yet in use.

Only a beginning has been made in hydroelectric development in the West, and with conservative public utility commissions to guard the proper issuance of bonds and expenditures from the funds thereby accruing, the enterprises should prove sound business investments to Eastern capital and of incalculable benefit to the future welfare of Western commonwealths.

A Western Branch of the Bureau of Standards

No one department of our national scientific organization seems to have won complete national confidence more quickly than the Bureau of Standards at Washington. Painstaking accuracy characterizes the scholarly papers and determinations sent forth from this bureau. So thoroughly has public confidence been acquired, an instrument checked and approved by the Bureau of Standards is universally accepted as the last work in care to be used in official engineering tests.

Although modern methods of rapid transportation seem almost literally to annihilate distance, yet the length of the journey inevitably jeopardizes the delicate adjustments of highly sensitive instruments. The climbing of the Cascades, the Sierra Nevadas and finally the Rocky Mountains often proves of questionable benefit to instruments on their way to and from the national laboratories at Washington. Long since a deep felt want has existed for a Western branch of the Bureau of Standards. Some weeks back the San Francisco Section of the American Institute of Electrical Engineers unanimously went on record as favoring an early establishment of a Western branch of the Bureau of Standards at the Western Metropolis.

That there should be a Western branch of the Bureau of Standards is not questioned by those who are familiar with engineering needs in this growing section of our country. In deciding upon the permanent location or home for such a branch institution, many considerations necessarily enter. A location as near the center of gravity of Western population as is possible appeals to all without further argument.

The location of a Western branch of the Bureau of Standards in a permanent Western home so that ready access may be had to it by engineers of the world during the great engineering and scientific congresses of 1915 would truly bring about a two-fold result. First it would accomplish the satisfying of a long felt Western want —a branch of the Bureau of Standards suitably located for Western needs—and secondly it would enable the government to effectually exhibit to the world in 1915 the great work now undertaken in this important department of our national scientific life.

But the consideration of actual location is after all a secondary issue. The growth of our great industries in the West has reached such vast proportions that a Western branch of the Bureau of Standards is indispensable. It is to be hoped that other Western scientific and engineering bodies will follow the example of the San Francisco Section of the American Institute of Electrical Engineers and demand the establishment at whatever place is found the best suited for all purposes at the earliest date possible a Western Branch of the U. S. Bureau of Standards.

PERSONALS.

George J. Henry Jr., hydraulic engineer, has returned to San Francisco from Los Angeles.

Will A. Doble, chief engineer of the Pelton Water Wheel Company, has been visiting Los Angeles.

C. F. Conn, of the engineering staff of J. G. White & Co.'s San Francisco office, is at Visalia on business.

F. B. Gleason, manager of the Western Electric Company's San Francisco branch, is on his way to New York City.

Paul Butte, of the Butte Engineering and Electric Company, has returned to San Francisco from the Pacific Northwest.

S. L. Shuffleton, manager of the Pacific Coast interests of the Stone & Webster Engineering Corporation, has gone to Seattle from Fresno.

Arnold Pfau, hydraulic engineer for the Allis-Chalmers Company, arrived on the Pacific Coast from Milwaukee via Los Angeles during the week.

Edson F. Adams, who is interested in several hydroelectric projects, including one on the Owens River, has returned to Oakland after an Eastern trip.

Will C. Caffray, California manager for the Detroit Fuse & Manufacturing Company, has returned to Los Angeles from the electrical contractors' convention at San Jose.

R. B. Williamson, an electrical engineer connected with the power and electrical department of the Allis-Chalmers Company, is at San Francisco on his first tour of the Pacific Coast.

H. L. Jackman, manager of the Humboldt County interests of the Western States Gas and Electric Company, with headquarters at Eureka, is among the recent arrivals at San Francisco.

R. G. Littler, of the West Coast Engineering Company, of Portland, has returned to that city after attending the national meeting of the electrical contractors at Denver and the California meeting at San Jose.

W. F. Durand, professor of mechanical engineering at Stanford University, was in San Francisco during the week and attended the weekly luncheon of the Engineers' Club at the Palace Hotel last Tuesday noon.

Morris Bien, a prominent engineer who has devoted much attention to reclamation work and irrigation engineering, is a recent San Francisco visitor. He is a graduate of the class of 1879 at the University of California.

C. C. Hillis, general manager of the Electric Appliance Company, left for the East during the past week, accompanied by his family. He will go as far as Pittsburg, remaining away about a month for business and recreation.

S. N. Griffith, of Fresno, who has had much to do with electric railway development in the San Joaquin Valley, is at San Francisco. He is quoted as saying that a good deal of such work is in progress or projected in that part of the State.

Sidney Sprout, consulting engineer for the California-Oregon Power Company, is again at the dam site on the lower Klamath River, where work is to be pushed vigorously for the balance of the year on an extensive hydroelectric development.

Boyd Ehle, of the New York office of Sanderson & Porter, has arrived at Victoria, B. C., and will be resident engineer on the new Sooke water supply which is being installed for the municipal government at that point. Wynn Meredith, of Sanderson & Porter's San Francisco office, is consulting engineer for this large project.

W. D'A. Ryan, the General Electric Company's illuminating engineer, is on his way from Schenectady to San Francisco to consult with the engineers of the Panama-Pacific Exposition on the illumination features of the World's Fair in 1915. It is the intention to have as much originality as possible in the lighting of the buildings and grounds.

H. R. Noack, president of Pierson, Roeding & Co., has returned to San Francisco after visiting Los Angeles and putting in the low bid on insulators for the 110,000-volt transmission line for the Los Angeles Aqueduct system. Sixty miles of line will be included in the initial installation, but the system will eventually be extended the entire length of the aqueduct, or about 220 miles.

Harry Hartwell, who has been for some time with Sanderson & Porter of New York as resident engineer on the new municipal water supply at Victoria, B. C., has just accepted a position with the F. S. Pearson Engineering Company of New York. He will shortly pass through California, inspecting the principal hydroelectric developments, while en route to New York City.

Otto E. Osthoff, one of the vice-president's of H. M. Byllesby & Company, of Chicago, has been spending a few days at San Francisco with a party of officials who are on an inspection tour of the plants operated on the Pacific Coast under the name of the Western States Gas & Electric Company. The group includes **M. McCalman**, supervising engineer; **J. W. Link**, hydraulic engineer, and **C. E. Groesbeck**, of Portland, who is the Pacific Coast representative.

Hyal V. Johnson, Jr., a district contractor for the Pacific Telephone & Telegraph Company, was instantly killed last Wednesday by an automobile accident on the Benicia road near Vallejo. He had been connected with the company eight years and resided in Oakland. A. F. Tucker, wire chief at Vallejo and E. E. Lincoln, Santa Rosa, district manager who were in the auto with Johnson when it overturned were seriously injured.

MEETING NOTICES.

The Rejuvenated Sons of Jove will meet at lunch at Tait's Cafe, San Francisco, at 12:30 on August 6. A full attendance is requested as several important matters will come up for discussion.

A number of electrical men of San Francisco are meeting at lunch on Wednesday at 12:30 at the Palace Hotel. The next meeting will be addressed by W. D'A. Ryan, illuminating engineer for the General Electric Company, who will investigate the illumination of the Panama-Pacific Exposition.

TRADE NOTES.

The Allis-Chalmers Company was the successful bidder on eleven pumping engines, 26 in. by 42 in. 36 in. stroke. for the General Pipe Line Company's new pumping stations which are to handle oil from the Esperanza wells.

The Kellogg Switchboard & Supply Company is installing a "phantom" circuit on the 60-mile telephone line of the Madera Sugar Pine Company, extending from Madera to the sawmill at Sugar Pine. The capacity of the line will be doubled at almost a nominal cost.

The General Electric Company has sold to the South Eureka Mine a 400-h.p., 440-volt, variable speed induction motor for use on a mine hoist. It will be mounted on the same shaft with another similar motor. The motors will be controlled by two separate contactor panels and a master-controller.

The Allis-Chalmers Company has been awarded a contract by the Pacific Light and Power Corporation for four big impulse wheels, capable of developing nearly 20,000 h.p. each for the new power stations on the Big Creek development. Each wheel will be direct connected to a generator rated at 11,000 kw. and will be operated under a head of about 2000 feet.

R. B. Elder, representing the Ideal Electric Manufacturing Company, reports the sale of eight 90 h.p. elevator motors for use in the Walker Bank Building at Salt Lake City. The Van Emon Elevator Company has the contract for constructing the elevators for this large office building. The special slow speed motors, operating at 280 r.p.m., will drive the traction elevators.

The Westinghouse Electric & Manufacturing Company reports the receipt of an order from the Pacific Gas & Electric Company, at San Francisco, of one 1000 kw., two-bearing, synchronous motor-generator set consisting of one 1000 kw., 550-700 volts, 514 r.p.m. direct-current generator, and one 1440 h.p. 2300-4000 volts, three-phase, 60-cycle, synchronous motor complete with switching equipment.

The General Electric Company has sold to the Pacific Gas & Electric Company two 1000-kw. motor-generator sets for use at San Francisco. Two switchboards are included in the contract. One of the new units will be installed at Substation C and the other at Substation G. Each unit consists of one 11,000-volt synchronous motor operating at 514 r.p.m., direct connected to one 550-volt d.c. generator

The commercial department of the Pacific Gas and Electric Company has secured a long-term contract with the Union Iron Works, under which all of the electric current needed for light and power purposes at the big ship-building and engineering plant will be supplied at a reasonable rate. This will enable the Union Iron Works to shut down its own electric power plant, which is of larger capacity than is required for the present needs of the shipyard.

Garnett Young, manager of the Telephone-Electric Equipment Company, announces the closing of a contract through the Telephone-Electric Equipment Company's Los Angeles office with the Board of Works of the city of Los Angeles for the bare copper cable for the Los Angeles aqueduct electric transmission system. The cable will cost more than a quarter of a million dollars, and forty cars will be required to transport it from the factory of the American Electrical Works, Phillipsdale, R. I., where it is to be manufactured. A thirty day delivery is promised on the cable which will be supplied in two sizes 350,000 circular mils and 300,000.

CONSERVATION COMMITTEE.

Representatives of the hydroelectric interests in California met July 26 for a conference in the office of John A. Britton of the Pacific Gas & Electric Company for the purpose of selecting a committee to represent these interests at a water power conference to be held either in San Francisco or Washington at the adjournment of the present session of Congress. The session will be called by Secretary Fisher of the Department of the Interior, and there will be representatives from the Geological Survey, the Forest Service, Agriculture Department, the Bureau of Corporations, the California Water Commission and the power companies of California.

Whether the conference is held in San Francisco or Washington will largely depend on the convenience of either city to Secretary Fisher, who has planned a trip to Hawaii. The object of the conference is to discuss the conservation of the hydroelectric resources of California on land owned by the State and the Federal legislation necessary to effect such an end.

At the conference the following committee was selected to represent the water power interests in the State: John A. Britton, chairman, representing the northern section of California; Guy C. Earl, Oakland, representing the central, and H. H. Trowbridge of Los Angeles, representing the southern. Among those who attended the meeting were: H. H. Noble, John B. Miller, A. W. Bullard, Sidney Sprout, Allen Chickering and Charles P. Cutten.

NEW CATALOGUES.

The Crocker-Wheeler Company of Ampere, N. J., has just issued bulletin No. 151, which deals with "Remek" distributing transformers, illustrating their manufacture in an interesting and attractive manner.

The Green Fuel Economizer Company, whose Pacific Coast representatives are Chas. C. Moore & Company, have issued a new 104 page catalogue on Green's Economizers, the first 70 pages of which are largely devoted to a discussion of recent developments in steam plant practice as affecting boiler efficiency and the economical recovery of heat from gases of combustion. A number of original and valuable charts are included.

The Ohio Brass Company have issued their new general catalogue No. 12 which gives a listing of their entire line, including catenary materials, 1500 volt materials, 750 volt overhead material, rail bonds, third rail insulators, O-B Hi-Tension insulators and car equipment specialties. The catalogue is bound in cloth and contains 490 pages which include besides the listing of the different devices considerable data relative to construction schemes.

The Westinghouse Electric Manufacturing Company has issued circular No. 1155, which deals with series arc lighting systems having Westinghouse-Cooper Hewitt rectifiers. Pamphlets on Westinghouse commutating-pole d.c. motors and special underwriters' motors, compound-wound, have also made their appearance in the trade circular No. 1516, is an attractive exposition of the Balwin-Westinghouse electric locomotives. It contains 63 pages of reading matter.

The Department of Publicity of the National Quality Lamp Division of General Electric Company has compiled and is distributing a "Mazda Ad Book," containing suggested models for newspaper advertising copy suitable for use by central stations, electrical dealers and contractors. The advertisements, which set forth the advantages of electric light and of "National Quality" Mazda lamps, are forcefully written and pointedly illustrated. The "Mazda Ad Book" has been strongly approved by the various concerns which have received copies of it, and successful results are being reported from its use.

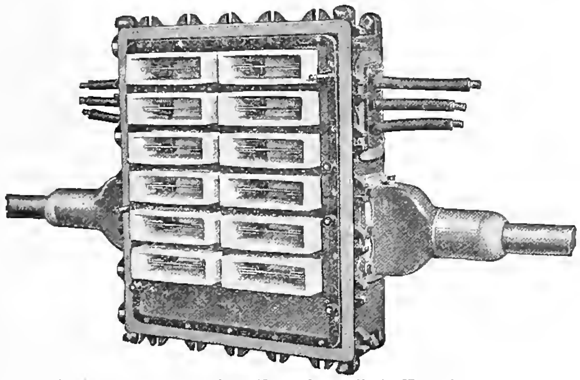
Bulletin No. 1139 of the Fort Wayne Electric Works of General Electric Company on Motor Drives is a handsome picture book showing the many applications of Fort Wayne motors to various machines used in several industries. Bulletin No. 1140 illustrates and describes Type S R Single-Phase Repulsion Induction Motors. Bulletin No. 1136 is devoted to Direct Connected Type M P L Direct Current Generators and No. 1137 to Belt Driven Revolving Field Alternators. Instruction Book No. 3053 is concerned with Multi-phase Revolving Field A.C. Generators and Belted Exciters.

The General Electric Company has just issued a number of valuable bulletins. No. 4966 is devoted to a description of Hydroelectric Power Developments, some of them in considerable detail. The bulletin contains numerous illustrations of both station and line construction. Bulletin 4953, entitled "Large Shell Type Transformers," endeavors to place before those interested some of the more important points regarding the relative merits of its different types of transformers. The Electrical Operation of Railroad Shops is the title of Bulletin No. 4959, which is profusely illustrated. Bulletin No. 4960 illustrates and describes direct current lightning arresters for use in connection with electric railways. Bulletin No. 4963 describes a complete line of small motors ranging in size from 1/50 to 1/4 h.p., inclusive, wound for either direct or alternating current. Bulletin No. 4962 is devoted to the use of Electric Power in the Lumber and Woodworking Industries.

INDUSTRIAL

A NEW CABLE JUNCTION BOX FOR HIGH TENSION TRANSMISSION CIRCUITS.

A new type of cable junction box suitable for the interconnection of high voltage feeders and mains is shown in the accompanying illustration. This is believed to be the first high voltage junction box made in this country. It will be noted that the flexible leads which project through the sides of the box are so arranged as to terminate within the large removable nipple. These nipples have a rounded or dome-shaped end made entirely of soft metal such as lead or lead-tin alloy. This dome-shaped portion is united with that portion of the nipple which is of brass or other rigid material by an exceedingly strong and absolutely water tight



A New Cable Junction Box for High Tension Transmission Circuits.

joint. The leads are connected to the outermost contact points of etach row of disconnecting switches, the innermost point being connected to bus-bars, giving the desired interconnecting arrangements.

The exposed live parts—that is, those shown in the cut—are isolated in cells of porcelain so that the disconnecting blades can be inserted or removed by means of insulated tongs with a maximum of safety. The porcelain cells are permanently fastened in a metal framework which, in turn, is fastened to the box, in such a manner that a chamber is formed between the framework of cells and the bottom and sides of the box.

This chamber, after the carrying parts that enter it are put in place and insulated with tape, when desired, and after the moisture has been removed by the heat and vacuum process, is filled with a hot insulating compound. Insulating stuffing boxes prevent the compound from oozing out along the flexible leads when the box again warms up under working load. The concealed current carrying parts of this box are, therefore, assembled and insulated before the box is sent out from the factory, where the work can be done with the greatest care by operators skilled in that particular work under expert supervision.

In order to make the cable connections, all that is necessary, is to unbolt the nipple from the box, cut off, with a saw or jack knife, the dome-shaped end of the soft metal portion of the nipple and, after threading it over the cable, joint the conductors to the insulated flexible lead. After this the nipple can be replaced, the joint wiped and the space within the nipple filled with hot Ozite insulating compound. The connection is then complete.

As the contact blades, when removed, leave the flexible leads dead, it will be readily seen that in this box one or more of the cables may be connected after the box is in service and while it is alive. This box is adapted for interconnecting two or more 1, 2, 3, or 4-conductor cables and may be used for alternating current or direct current circuits.

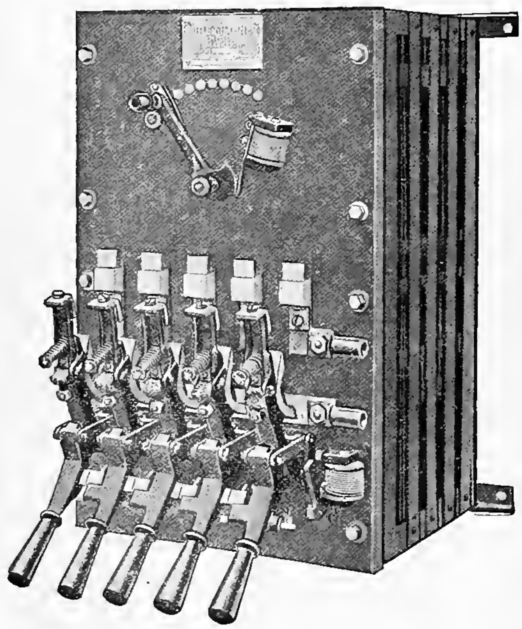
These boxes have been used in considerable quantities on circuits of 4500 volts working pressure for a period of nearly two years with satisfactory results. In other installations they are operating at 5000 volts. The same general design is suitable for still higher voltage.

An interesting reference to the box and its use in one of the largest underground systems in the United States (That of the Pacific Gas & Electric Company), is given in the April Proceedings of the A. I. E. E. in a paper by Messrs. Lisberger and Wilson. These boxes were originally designed to meet the needs of Mr. Lisberger who is chief engineer of the Pacific Gas & Electric Company, and who co-operated with the manufacturer in bringing the design to its fruition.

This box is protected by U. S. Letters Patents and is manufactured by the Standard Underground Cable Company, of Pittsbugh, Pa. It presents some new and interesting features which make for greater flexibility and convenience in this class of equipment.

NEW CUTLER-HAMMER STARTING AND REGULATING CONTROLLER.

A new type of controller for medium and large capacity direct current motors has been placed on the market by The Cutler-Hammer Manufacturing Company of Milwaukee. This controller consists of a multiple switch starter and a shunt field type speed regulator. The starting portion is similar to the standard Cutler-Hammer multiple switch starter designed for use with large motors or with motors of medium size when the starting conditions are severe. Each of the individual levers, when closed, cuts out a step



New Standard Type Cutler-Hammer Starting and Regulating Controller

of armature resistance bringing the motor up to normal speed. The field regulating rheostat mounted above, as shown in the illustration of a 50 h.p., 230 volt type, consists of a series of field resistance steps controlled by a single lever.

When the motor has been properly accelerated to normal speed by cutting out the armature resistance, the field regulating resistance may then be used to secure further increase in speed. If the main line switch is opened or the current supply interrupted, the no-voltage release on the starter opens the starting switches and this, in turn, deenergizes the no-voltage release of the field rheostat, causing the lever to return to the "full field" position.

D.C. SWITCHBOARD METERS.

The D'Arsonval principal consists of the use of a measuring coil without iron, moving in a perfect magnetic field. Direct-current measuring instruments that operate on this principle have inherently the advantage of being entirely free from the effects of residual magnetism, because there is no iron in which the flux is caused to change during the measurement. Further, they make it possible to obtain a uniformly graduated scale by simply providing a uniformly distributed field in the air gap in which the coil moves. These inherent advantages are important, and cannot be obtained with any other type of construction.

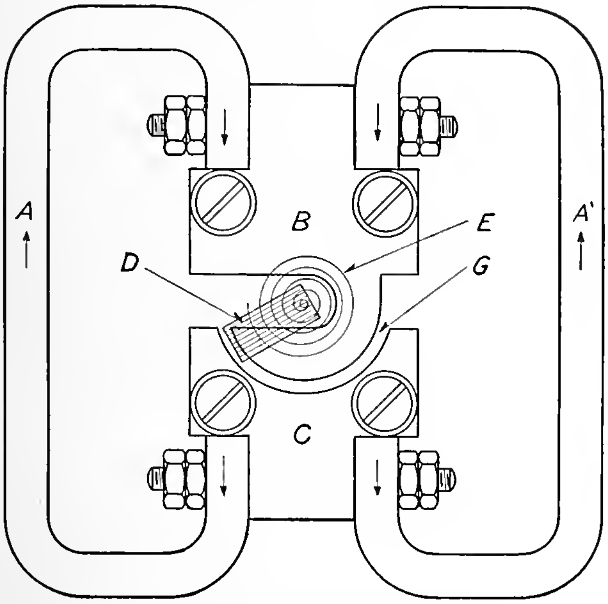


Fig. 1. Diagram Showing Single Air Gap Arrangement of Westinghouse D. C. Meters.

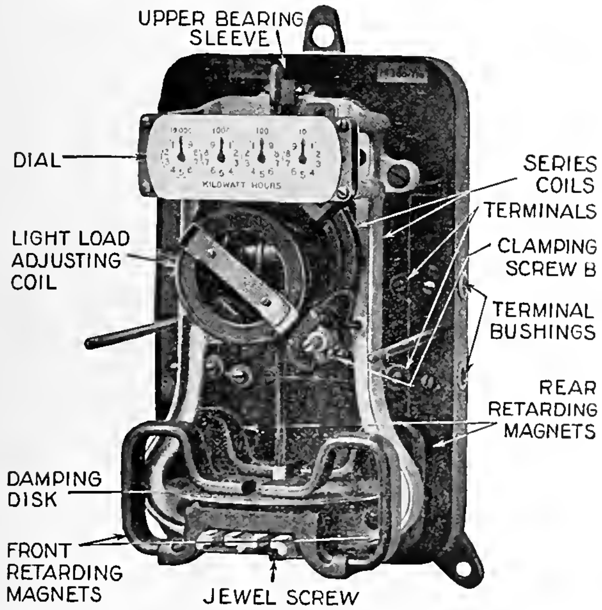


Fig. 2. Moving Element of Westinghouse D. C. Meters.

In the line of 5-inch, 7-inch and 9-inch direct-current meters recently brought out by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., a unique adaption of this principle is used. The magnetic circuit, consisting of two permanent magnets with pole pieces has only one air gap. The moving coil is pivoted at one side and the opposite side moves in this air gap. This construction, in addition to providing one air gap with large clearance, instead of two air gaps with small clearance, as is generally the case, also makes possible a better balancing of the pointer and results in a number of minor advantages.

The complete magnetic circuit, including the pole pieces, is magnetized and aged as a unit, a process possible only with the single air gap construction because the pole piece does not have to be removed to put the moving element in place. The parts of the magnetic circuit therefore are not changed in assembling the meter after aging so that the strength is not disturbed in any way.

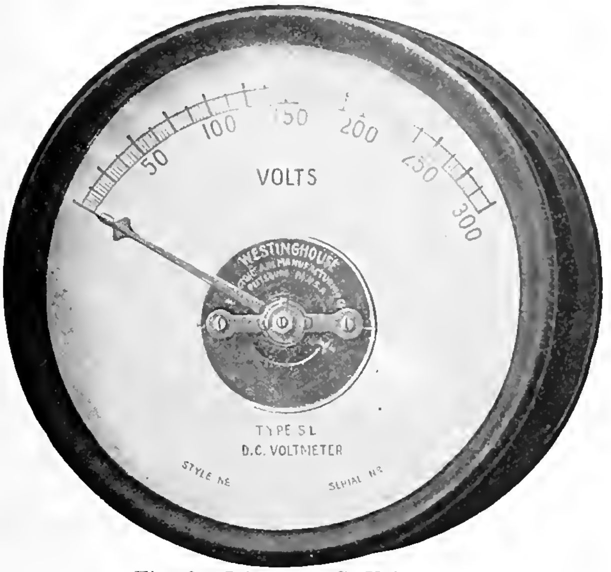


Fig. 3. 7-inch D. C. Voltmeter.

The scales of the meters are calibrated by hand, to give more uniform accuracy than is possible with printed dials.

The meters are furnished as voltmeters and ammeters, in six types: 5-inch, 7-inch and 9-inch round types, also illuminated dial, vertical edgewise, and portable types. The 7-inch round type, because of the length of its scale and flat glass front, marks a distinct advance in meter design. It

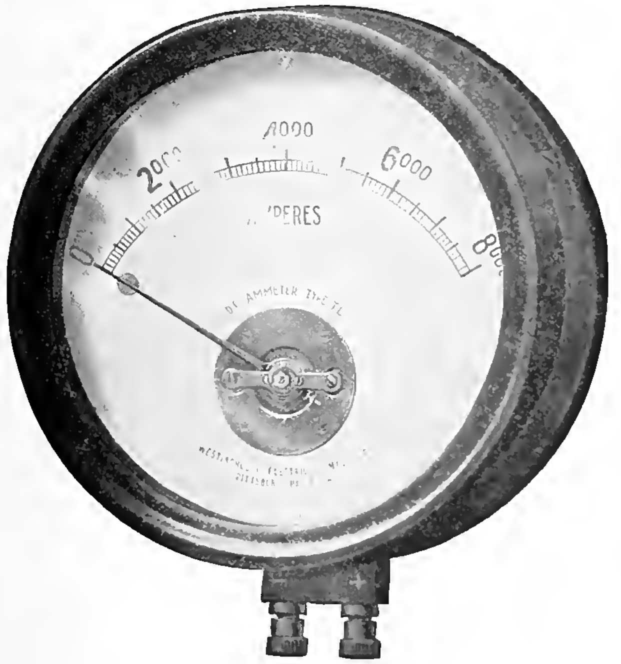


Fig. 4. 7-inch D. C. Ammeter.

will be noted that it can be enclosed in a rectangle of less than 55 square inches, so that it occupies practically as little switchboard space as the smallest "edgewise" meters on the market. At the same time its scale is 7 inches long—as long as the scales on most 9-inch meters, making the indications clearly readable. The flat glass front, exposing the entire pointer to view, adds to the readability and makes it possible to avoid the troublesome reflections encountered in the use of meters with curved scale.

NEWS NOTES

INCORPORATIONS.

SULTAN, WASH.—The Sultan Electric Company has heen incorporated at $15,000.

NORTH YAKIMA, WASH.—The Nile Telephone Company, Nile Valley, Yakima county, has been incorporated with a capital of $2400.

GREAT FALLS, MONT.—The Montana Natural Gas Company has filed articles, its object being to install and operate a gas plant here. H. C. Price is interested.

EL PASO, TEX.—The Rio Grande Valley Traction Company which will construct and operate an interurban road down the valley 14 miles distance, has filed articles of incorporation.

VENTURA, CAL.—Moorpark Water, Light & Power Company, $10,000, subscribed $1250, by R. E. Young, E. C. Graham, J. M. Cornett, R. C. Lydston, J. C. Smith, F. M. Cornett and J. M. Stewart.

VALLEJO, CAL.—Vallejo and Napa Valley Gas & Oil Company, $500,000, subscribed $500, by J. O. Hanscom, J. Hancock, and C. Winchell of Vallejo and Walter Rutherford and W. H. Babb of Napa.

ILLUMINATION.

LOS ANGELES, CAL.—The Southern California Gas Company has applied for permission to serve Vernon and Compton, Los Angeles County.

NEW WESTMINSTER, B. C.—The City Council has awarded the contract for the electric lighting plant to the Canadian General Electric Company.

RIVERSIDE, CAL.—The City Council has approved the recommendations of the Board of Public Utilities for the installation of an ornamental lighting system.

SAN DIEGO, CAL.—The Imperial Valley Gas Company has applied for permission to issue $200,000 of 6 per cent bonds, with which to extend its mains to a number of towns, including Calexico and Maxicali.

FAIRFIELD CAL.—An application has been made by the Great Western Power Company for a franchise for electric transmission lines in this city. Sealed bids will be received up to August 27, 1912, for the sale of said franchise.

GLENDALE, CAL.—Manager Harry B. Lynch of this city's lighting department, has started negotiations with Pasadena to serve Glendale with electricity during that time when the city's present contract expires in November and the time when the Owens River power is procurable.

TRANSPORTATION.

SOUTH BEND, WASH.—The Willapa Harbor Telephone Company has decided to build a new line from this city to Bay Center.

FREEWATER, ORE.—The surveyors of the Walla Walla Railway Company are laying out a new electric railway from this place to Hudson Bay.

POMONA, CAL.—Installation of switches and tracks, conmeeting the Pacific Electric terminus at San Dimas to the Southern Pacific tracks to Pomona, was completed July 23, and work will begin at once on electrifying the road.

SANTA BARBARA, CAL.—The 45-year street railway franchise has finally been awarded to the Cochran-Batchelder Company, who have agreed to reconstruct the local system and double track the main streets; $250,000 will be expended. Reconstruction work on the system will start within 60 days.

GLENDALE, CAL.—R. A. Blackburn, chairman of the railway committee, appointed by the Chamber of Commerce to consult with Paul Shoup of the Pacific Electric Company, reports that the railway company will construct a line on the east side of Glendale, and that about August 1 the company will be ready to present a definite route.

SAN FRANCISCO, CAL.—The normal rate of progress scheduled in the plans for the building of the Geary street railroad has been reached by the contractors, Mahoney Bros., and the present direction of the curve on the progress sheet posted in the Supervisors' room indicates that they will finish the work ahead of time and gain some of the bonus offered.

SAN FRANCISCO, CAL.—The State Railroad Commission has called upon the electric railways of the State for a statement of their profit and loss accounts, and a balance sheet for the year ending June 30, 1912. The statements must he submitted on forms supplied by the Commission, and uniform statistics will be kept on file in the office of the Commission.

MARYSVILLE, CAL.—According to figures shown here by Assistant Secretary George Springer of the Northern Electric Company, that road has increased its earnings about 10 per cent in the fiscal year that has just closed. The gross earnings of the road during the year which ended June 30 were $620,762.34, the operating expenses in the tame time amounted to $412,824.21, leaving the net earnings, $207,938.63. The net earnings for the year ending June 30, 1911, were 10 per cent less.

MARYSVILLE, CAL.—Traffic on the Marysville-Colusa branch of the Northern Electric Railroad has commenced with a construction train making two trips daily between Marysville and Butte Slough. In a week or ten days this service will be extended to Meridian. The bridge work at Meridian will prevent traffic being extended to Colusa for some time, but the grading on the Colusa side is being completed and the track will he made ready in advance of the completion of the bridge. By the first of the coming year the line should be in operation from Marysville.

RICHMOND, CAL.—News that is looked upon as authentic has heen received here that the S. P. Company has appropriated $1,085,000 with which to build its electric system into Richmond, using the Cutting-boulevard and Tenth-street franchises, which will give them entry to the most populous parts of Richmond and open the way for a loop around by the Standard oil works. Under the terms of the franchise granted work must begin by August 15, and the statement is made that $50,000 is ready to start grading by that time.

SAN BERNARDINO, CAL.—Pacific Electric surveyors have completed the survey of the extension of the local Arrowhead Hot Springs line to the hotel. When the extension is completed and the San Bernardino-Los Angeles trunk line is built, through cars to the springs will be run from Los Angeles.

TRANSMISSION.

SAN MATEO, CAL.—The Halfmoon Bay Light & Power Company has applied to the Railroad Commissioner for permission to increase its capital stock from $25,000 to $100,000, in order to build 75 miles of extensions with which to serve practically all the towns on the Ocean Shore Railway in San Mateo County.

OLYMPIA, WASH.—A complaint has been filed with the public service commission by the council of the town of Cashmere, in Chelan County, alleging that a power company refuses to remove high tension transmission wires from the main street of the town in spite of the wishes of the council and an agreement entered into previously.

TELEPHONE AND TELEGRAPH.

HOOD RIVER, ORE.—The Home Telephone Company will install the auto-manual system of exchange here.

DEMING, N. M.—The Mountain States Telephone & Telegraph Company has decided to establish district headquarters in Deming.

SANTA ANA, CAL.—The Pacific Telephone & Telegraph Company has purchased a 20-year franchise for an underground system of conduits.

DAYTON, WASH.—The county commissioners have granted Roy McBride permission to construct a telephone line on the Tucanon and Walker range.

KALAMA, WASH.—The Toutle Rural Telephone Company has been granted a franchise to maintain and operate a telephone line along certain county roads.

DAVENPORT, WASH.—The Washington Consolidated Telephone & Telegraph Company contemplates the construction of a line south from here to Harrington, Sprague and Odessa.

OAKESDALE, WASH.—H. Higgs of Rosalia has purchased the Oakesdale telephone exchange and will establish connections with all city and country lines in Oakesdale and vicinity.

CLARA, MONT.—Farmers in the northwestern part of Musselshell county, Mont., have organized a telephone company for building a line from this place to some point on the railroad.

TROPICO, CAL.—The Board of Trustees will receive sealed bids up to September 5 for franchise granting the right to construct a telephone and telegraph system along the streets of this town.

PORTLAND, ORE.—Portland officials of the Pacific Telephone & Telegraph Company are awaiting plans for the skyscraper which is to be erected by the company at the corner of Park and Oak streets. The building will be 12 stories high.

SACRAMENTO, CAL.—The Third District Court of Appeals has granted a writ of mandate asked by the California Telephone & Light Company of Santa Rosa against the Secretary of State to compel him to file its amended articles of incorporation. The Secretary of State's refusal, based on an opinion from the Attorney-General's office, was made because the company had failed to file with its amended articles copies of notarial acknowledgements contained in the original articles.

WATERWORKS.

LOS ANGELES, CAL.—Sealed bids will be received up to August 6 for the installation and rental of fire hydrants from day of approval of contract until June 30, 1913, at any point on mains of the Union Hollywood Water Company within the corporate limits of the city.

PORTERVILLE, CAL.—City Water Superintendent J. E. Curd has reported to the City Council that despite the completion this spring of an auxiliary water plant for the city, steps must be taken at once to again increase the capacity of the plant with a new well and the installation of new machinery. It is reported that plans will be considered immediately for a new well, in the hope of developing a bore which will yield up to 75 inches of water.

TULARE, CAL.—With all necessary data in the hands of the Board of Trustees submitted by Sloan & Robson, engineers, the board will at the next meeting give direction for the calling of an election to vote a bond issue of $100,000 for municipal waterworks. The election, according to the present plans of the board, will be held some time in September.

RIALTO, CAL.—The Fontana Union Water Company plans for development, involving both underground conservation and reservoir storage, and is preparing to issue bonds to the limit of $900,000 to cover the costs. The bonds are to be of the denomination of $1000 each at 6 per cent.

LOS ANGELES, CAL.—Sealed bids will be received up to August 26, for a franchise granting the right to construct a system of water pipes in the public highways of the county of Los Angeles.

TAFT, CAL.—The City Trustees have passed a resolution of intention to install a system of water mains to be used for fire and other purposes in the city and the city attorney has been directed to prepare an ordinance calling for an election on bonds for $12,000 for this purpose.

RICHMOND, CAL.—As the first step toward securing relief against alleged overcharges by the Peoples Water Company and poor service to its consumers in this city the Council has instructed City Clerk I. R. Vankhn to communicate with the Railroad Commission and ask that body to probe the local concern under the provisions of the public utilities act. The Council also named a committee composed of Councilmen J. E. Follett, E. J. Barrard and O. R. Ludewig to cooperate with the committees of the various civic bodies regarding the formation of a water district for the entire city to vote bonds for the building of a municipally owned water system.

ESCONDIDO, CAL.—The Directors of the Escondido Mutual Water Company and Trustees of the city have agreed to have the city purchase the present water distributing system; also to secure on the part of the Escondido Mutual Water Company authorization of an issue of bonds to the amount of $150,000 for developing a greater water supply by increasing the height of the present dam of said company and securing land for additional reservoirs and building necessary dam or dams, the same to be determined after thorough investigation by a competent engineer to be selected by said company.

WOODLAND, CAL.—Out of the 50,000 acres required for perpetual water rights by the Yolo Water & Power Company to justify an expenditure of $2,000,000 for the enlarging and improving of the irrigation system in this county, between 30,000 and 35,000 acres have been pledged, and all the lists for acreage have not been returned yet. The committee that has in charge the solicitation of agreements upon the part of farmers who pledge an acreage to the Yolo County Power & Water Company that will justify the company in the expenditure of $2,000,000 or more for improvements, has reports aggregating between 30,000 and 35,000 acres. Some lists are out that have not been heard from. Only 50,000 acres are required and when that amount is signed up the work will commence.

LOS ANGELES, CAL.—The annual report of William Mulhalland, chief engineer of the aqueduct, read at the meeting of the aqueduct advisory board, showed that, while the aqueduct force is working on a schedule of completion by January 1, 1913, the big ditch and the aqueduct power system are expected to be completed by March 1, 1913.

RIVERSIDE, CAL.—A municipal water system for Riverside seems assured through the approval by the city council of the contract for the purchase of the domestic system of the Riverside Water Company, and the indorsement of this contract by a commission from the directorate of the water company.

PASADENA, CAL.—An ordinance has been framed providing for the issuance of bonds in the amount of $1,250,000 for levying of a tax to pay the principal and the interest upon said bonds to be used for waterworks and a system for supplying water to said city. Said bonds shall be of the denomination of $1000 each, numbered from 1 to 1250, bearing 4½ per cent interest, payable semi-annually, October 1 and April 1.

LOS ANGELES, CAL.—The Funding Company of California has just acquired the People's Water Company of Palms and plans to sink new wells, extend the mains, laterals and improve conditions in general.

ALPHABETICAL INDEX TO ADVERTISERS

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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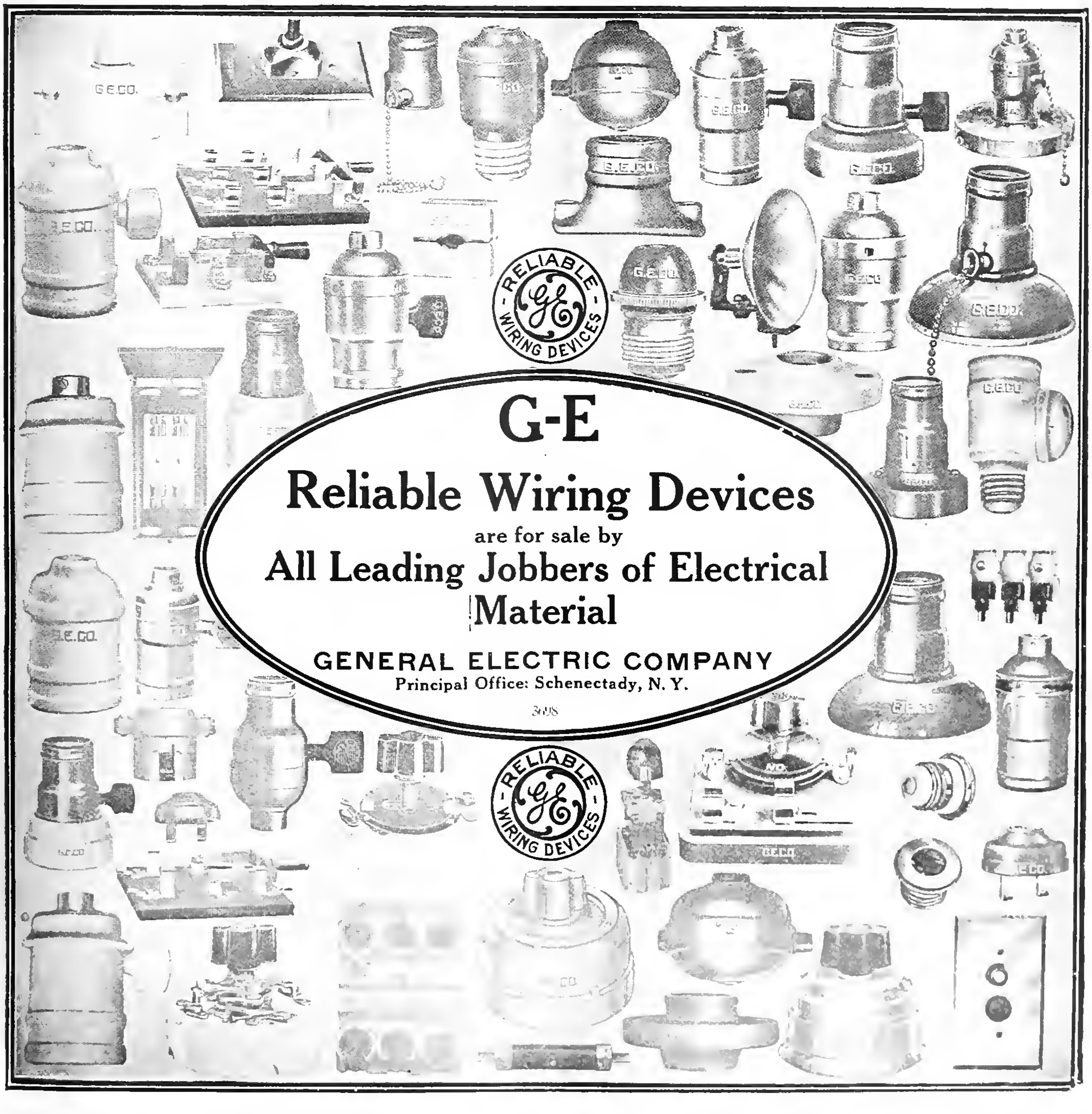


Where to Buy It in the West, Pages 9, 10, 11 Alphabetical Index to Advertisers, Page 8.

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXIX | SAN FRANCISCO, AUGUST 10, 1912 | NUMBER 6

LIGHTING EQUIPMENT OF FERRY STEAMER "THOROUGHFARE"

BY H. A. RUSSELL.

There was recently added to the transportation facilities of San Francisco Bay a double end ferry 273 ft. long, with a gross tonnage of 3600, driven by two tandem compound engines of 1340 indicated horsepower. This steamer (see Fig. 1), was built for the Southern Pacific Company, and was expressly designed for the transportation of automobiles across the bay between San Francisco and Oakland.

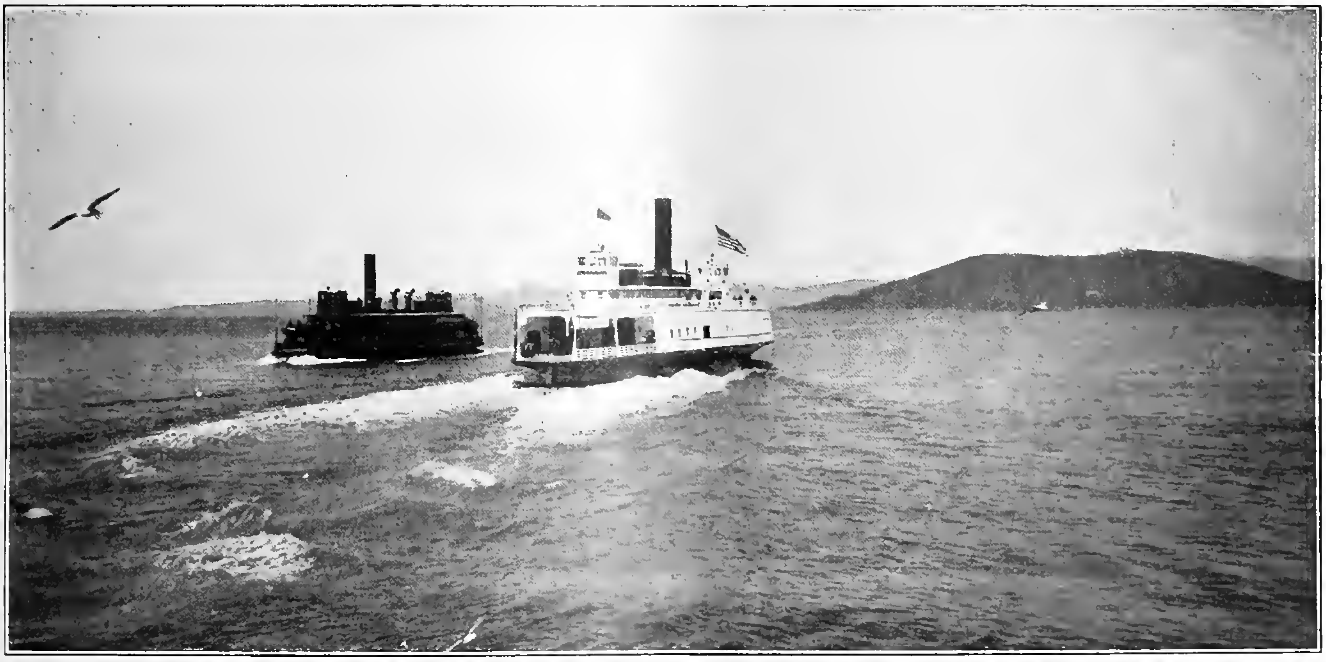


Fig. 1. Ferry Steamer "Thoroughfare."

When it was decided to equip the new steamer with electric searchlights it was found that there was not sufficient room in the engine compartment to house additional engine-driven generators to supply current for the searchlight projectors. Under these conditions it was decided to take advantage of the compact arrangement and relatively light weight of the Curtis steam turbo-generator, and two units of 25 kw. capacity were secured from the General Electric Company and installed on a level with a gallery platform in the engine room, but were separately supported by iron brackets fastened to the side of the ship. The turbo-generators when mounted in this way were 9 ft. above the keel, and as they did not occupy space which could otherwise be utilized, they did not interfere in any way with the original layout of the engine room. The appearance of these generator sets is shown in the accompanying illustration, Fig. 2. They operate condensing at 3600 r.p.m., utilizing 175 lb. steam pressure with 26 in. vacuum. They are provided with throttle valve, steam gauge, oil pressure gauge, separate regulating governor, and, in addition, are equipped with emergency stops. They are direct connected to the main steam pipe line.

The generators are compound wound machines and deliver direct current at 110 volts. The searchlights are standard 13-in. General Electric pilot house control type, equipped with silver glass mirrors, and are installed on the tops of the two pilot houses. By means of a single lever, which is within easy reach of the pilot, the beam of light can be readily moved in either a horizontal or vertical direction and the pro-

jector may be locked at any desired angle by simply turning the handle of the lever until it binds against the quadrant.

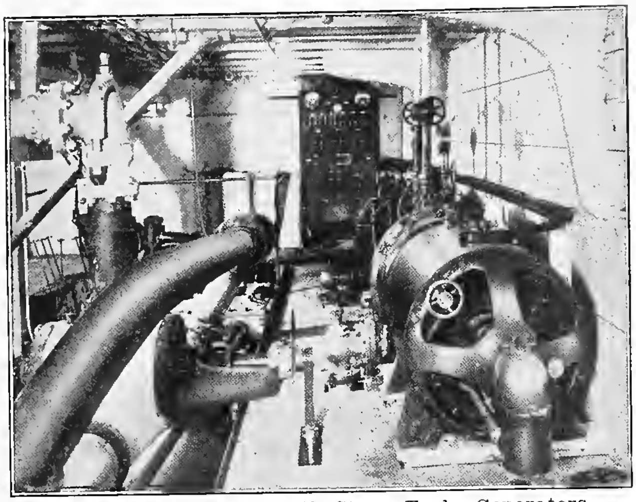


Fig. 2. Two 25 kw. Curtis Steam Turbo-Generators and Switchboard.

The control panel for the turbo-generators is installed at one end of the platform containing the lighting sets, and the field rheostats are mounted back of the panel board.

Fig. 3. San Francisco Ferry Tower Illuminated by Ferry Boat Searchlight.

In addition to the searchlights the steamer is provided with two sets of electric running lights with auxiliary tell-tale boards, which give a constant indication of the condition of the lights, while for the ordinary lighting throughout the ship, 250 16 c.p. incandescent lamps have been provided.

SAFEGUARDING THE CHILDREN.

The many distressing accidents in our Western cities during the past year among the children playing in the streets where electric cars and vehicles are passing constantly have lead serious-minded citizens to endeavor to provide ways and means for a lessening in the fearful death toll.

In the great city of Philadelphia an accident prevention crusade under the leadership of the Philadelphia Rapid Transit Company has resulted in formulating rules of warning to the children and parents. The rules with the assistance of the board of education have been placed in the hands of thousands of parents and children. Good results are already being experienced.

Instruct your little ones to look in both directions before attempting to cross, particularly upon double-tracked streets. The middle of the block is always dangerous—use the crosswalks.

Strangely enough, the usually harmless game of "tag" adds heavily each year to the total number of those injured in the public streets.

The spirit with which most children enter into the game makes them quite careless of almost every form of danger.

Whenever possible, children should be encouraged to make use of the public playgrounds for their sports, instead of the crowded city streets. Frequent cautionings will prevent many accidents of this character.

Teach the children:

To head the warning gong or horn.

To make safety their first thought.

To give moving vehicles the right of way.

To let fallen or dangling wires alone.

To play ball or tag on the lots and not in the streets.

To be careful at railroad crossings.

To avoid dangerous places while roller skating.

To keep away from open ditches, lumber or brick piles.

To never "hook rides" upon cars, wagons, or automobiles.

To wait until the car has stopped before attempting to get on or off.

TOO MANY COATS OF PAINT DO NOT PROTECT THE IRON.

In an article on the subject of the protective qualities of paint in the Zeitchrift fur Elektrochemie for February 1, 1912, and abstracted in the A. S. M. E. Journal, it was stated that the commonly accepted belief that several coats of paint protect iron from rusting better than one coat is fallacious. The author's experiments with many kinds of paint have uniformly shown that the tendency of iron to rust was in direct proportion to the number of coats of paint which were applied. This phenomenon is believed to be due to electric action at the surface of the iron with the different coats of paint, the greater number of points of contact with different layers giving rise to a greater electrolytic action.

CRITICISM OF PRESENT CALIFORNIA LAW ON OVERHEAD CONSTRUCTION.

Much discussion has of late appeared in the columns of this Journal relative to the present California law on overhead construction.

At a meeting of the California delegates to the convention of the National Electric Light Association at Seattle recently, a definite movement was started for securing the revision of the California State Law governing overhead line construction. This law is known as chapter 499, Statutes of 1911, and was printed in full in these columns in our issue of February 3, 1912. Further discussion appears in our issue of June 22, 1912.

Represented at the meeting held in Seattle were a number of the largest operating companies in California and it was agreed that each company would immediately make a draft of the changes which would be necessary in the law, in order to make it a safe and efficient regulation, the understanding being that a joint meeting would be held at some central point for the purpose of agreeing on a final draft for submission to the proper authorities.

Mr. E. R. Northmore represented the Los Angeles Gas & Electric Corporation at Seattle and at his request, the Joint Pole Committee of Los Angeles has held a number of meetings for the discussion of all phases of the law. In this issue of the Journal is found a criticism and draft of a revised law which are the result of the Committee's deliberations. It should not be inferred that this draft is considered a model in any respect but some of the impossible features of the existing law have been eliminated. The committee are a unit in recommending the repeal of the entire law and the substitution therefor of the specifications of the National Electric Light Association.

A meeting will be held in San Francisco at an early date for final discussion of this subject.

Some Notes on the Present Law.

Paragraphs (a) and (b): The standard distance of thirteen (13) in. from center of pole to wire or cable has been selected without any apparent good reason. On open wire work for telephone, telegraph or signal service, it is sufficient, but it is not enough for wires carrying six hundred volts or over. Fifteen (15) in. would be better for a minimum on such work. On the other hand there does not seem to be any reason for the compulsory installation of cable cross-arms. Where there are not more than two cables, it would be much better to attach them directly to one side of pole, and insist that they should be at least six (6) ft. from any wires or cables carrying more than six hundred volts of electricity.

Paragraph (c): This paragraph is ambiguous and is being interpreted in many ways. Primarily, it provides a minimum clearance of four (4) ft. between wires carrying more than six hundred volts of electricity and wires carrying less than six hundred volts, and then proceeds to modify this regulation for combination or joint construction. It does not limit distance to be maintained between wires of the same voltage, and in this respect permits dangerous construction to be maintained, notwithstanding its restrictions. It provides further, that in combination or joint construction; that is, where two or more companies, for the distribution of electric light and power, occupy the same poles, the high voltage wires shall be on one side of the pole and the low voltage wires on the other side of the pole provided, that a distance of three (3) ft. is maintained between high and low voltage wires in a horizontal line and provided, crossarms are three (3) ft. apart in a vertical line, that is, provided, high and low voltage wires are approximately forty-one (41) in. apart in a vertical line. It is a rather doubtful point as to whether it is compulsory for two or more companies, occupying the same poles, to place all their high voltage wires on one side of the pole and all the low voltage wires on the other side of the pole, adopting the clearances as above, or, it may be possible to adopt the straight four (4) ft. vertical clearance between wires, and still the doubt would exist as to the proper position for the high and low voltage wires. Again, construction may be installed by one party complying with the four (4) ft. regulation clearance and when a second party desires to combine on the same poles, the first party is compelled to reduce clearances and reconstruct under entirely different standards. Again, there is the doubt as to what constitutes a distributing company. According to this law, it is necessary to place all wires carrying more than six hundred volts on one side of the pole and all wires carrying less than six hundred volts on the other side of the pole wherever joint construction exists. According to this regulation, a company would be justified in believing that it should place its high voltage lines on crossarms on one side of a pole and possibly its telephone line on the same crossarm on the other side of the pole provided, the horizontal distance of three (3) ft. is maintained between such wires. This would represent possibly the worst type of construction that could be devised. Again, there is the difficulty of "buck-arming" or leading off from a circuit at corners or elsewhere. Exception is made for service wires which may be installed at any desired distance from wires of other voltages, yet when it is necessary to "buck," it is compulsory to maintain at least four (4) ft. between wires carrying more than six hundred volts and wires carrying less than six hundred volts. This throws the line arms at least eight (8) ft. apart and on combination work introduces almost an insurmountable condition at corners where even with high poles, cross leads are obstructed to an unnecessary degree. It should be permitted to maintain levels at corners by "buck-arming" with a minimum two (2) ft. clearance between wires. The same regulation should apply to service wires.

Paragraph (e): No insulation is desirable or necessary in guys attached to steel poles or towers which are thoroughly grounded. It is not necessary to space guys, attached to same pole, one (1) ft. apart, except when they are attached to the same anchorage.

Paragraph (h): This is a most useless provision in its present form. The high pole, short span construction is excellent, but can not be adopted except on narrow private rights of way or alleys, and as a standard, is not applicable generally. Double strength construction means nothing if existing construction

is inherently weak and defective. This paragraph should be amended to comply with Standard Crossing Specifications.

Paragraph (i): This could be eliminated from the law entirely, without affecting the efficiency of same. An examination of all the methods adopted to comply with this provision show that it has accomplished one thing only, that is, it has introduced extra elements or fixtures, any part of which is not stronger than the single bolt clamp commonly used heretofore. All side strains should be provided for in a much better manner than provided for in this law, but otherwise no additional parts should be introduced than those heretofore in use.

Section (3): No insulator is necessary in span between trolley wires. There is some question as to the correctness of the distance from pole at which span insulators are installed. As a protection to linemen, the present regulation is satisfactory. Some telephone companies would like to see the distance increased, so as to place the insulators at least five (5) ft. from pole.

Conclusions.

As it exists today, the law is a most incomplete specification covering overhead construction. There can be no doubt that it would be of mutual advantage to all concerned if the specifications of the National Electric Light Association were adopted in California as a standard instead of this law. These specifications have the approval not only of the National Electric Light Association, but also of the American Institute of Electrical Engineers, American Electric Railway Engineering Association, Association of Railway Telegraph Superintendents, and American Railway Engineering and Maintenance of Way Association, and it has been the result of many years of study of the various committees of these associations. In lieu of this, the law should be amended so as to be interpreted easily, and it would be well if drawings were prepared to supplement its general provisions. As long as it is on the statute books in its present form, it will lead to constant and continual misunderstandings. It is not reasonable to suppose that even the principal features of a satisfactory regulation could be provided in the few paragraphs covered by this law.

PROPOSED LAW ON OVERHEAD CONSTRUCTION.

(With changes as recommended by the Joint Pole Committee, Los Angeles, Cal.

An act regulating the placing, erection, use and maintenance of electric poles, wires, cables and appliances, and providing the punishment for the violation thereof.

Section 1. No commission, officer, agent or employe of the State of California, or of any city and county or city or county or other political subdivision thereof, and no other person, firm, or corporation shall

(a) Run, place, erect or maintain any wire or cable used to conduct or carry electricity, on any pole, or any crossarm, bracket or other appliance attached to such pole, within a distance of thirteen (13) in. from the center line of said pole; provided, that the foregoing provisions of this paragraph (a) shall be held not to apply to one or two telephone cables attached directly to one side of a pole and which are installed at least six (6) feet, at point of attachment, from any wire or cable carrying at any one time more than six hundred volts of electricity; and further provided, that the foregoing provisions shall be held not to apply to telephone, telegraph or other "signal" wires or cables which are attached to a pole to which is attached no wire or cable other than telephone, telegraph or other "signal" wire or cable, except within the corporate limits of any city or town which shall have been incorporated as a municipality, nor shall the foregoing provisions be held to apply to such wires or cables in cases where the same are run from underground and placed vertically on poles, nor to "bridle" or "jumper" wires on any pole which are attached to telephone, telegraph or other "signal" wires on the same pole, nor to any "aerial" cable, as between such cable and any pole on which it originates or terminates, nor to wires run from "lead" wires to arc lamps or to transformers placed upon poles, nor to any wire or cable where the same is attached to the top of a pole, as between it and the said pole, nor to any "aerial" cable containing telephone, telegraph or other "signal" wires where the same is attached to a pole on which no other wires or cables than wires continuing from said cable are maintained, provided, that electric light or power wires or cables are in no case maintained on the same side of the street or highway on which said "aerial" cable is placed.

(b) Run, place, erect or maintain in the vicinity of any pole (and unattached thereto) within the distance of thirteen (13) in. from the center line of said pole, any wire or cable used to conduct or carry electricity, or place, erect or maintain any pole (to which is attached any wire or cable used to conduct or carry electricity) within the distance of thirteen (13) in. (measured from the center of such pole) from any wire or cable used to conduct or carry electricity; provided, that as between any wire or cable and any pole as in this paragraph (b) named, only the wire, cable or pole last in point of time run, placed or erected, shall be held to be run, placed, erected or maintained in violation of the provisions of this paragraph; and further provided, that the foregoing provisions of this paragraph (b) shall be held not to apply to one or two telephone cables attached directly to one side of a pole and which are installed at least six (6) ft., at point of attachment, from any wire or cable carrying at any one time more than six hundred volts of electricity; and further provided, that this shall not be held to apply to telephone, telegraph or other "signal" wires or cables on poles to which are attached no other wires, as between such wires and poles to which are attached no other wires or cables than telephone, telegraph or other "signal" wires, provided such wires, cables and poles are not within the corporate limits of any town or city which shall have been incorporated as a municipality.

(c) Run, place, erect or maintain, above ground, within the distance of four (4) ft. from any wire or cable conducting or carrying less than six hundred volts of electricity, any wire or cable which shall conduct or carry at any one time more than six hundred volts of electricity, or run, place, erect or maintain within the distance of four (4) ft. from any wire or cable which shall conduct or carry at any one time more than six hundred volts of electricity any wire or cable conducting or carrying less than six hundred volts of electricity; and further provided, that wires or cables carrying more than six hundred volts of electricity may be placed on same crossarm with wires or cables carrying less than six hundred volts of electricity, if the space between any wire or cable carrying or conducting at any one time more than six hundred volts of electricity and any wire or cable carrying less than said voltage shall be at least three (3) ft. clear measurement in a horizontal line and four (4) ft. in a vertical direction; provided, that the foregoing provisions of this paragraph (c) shall be held not to apply to any wires or cables attached to a transformer, arc or incandescent lamp, within a distance of four (4) ft., (measured along the line of said wire or cable) from the point where such wire or cable is attached to such transformer, arc or incandescent lamp, nor to wires or cables within buildings or other structures, nor to wires or cables where the same are run from underground and placed vertically on poles, nor to any "lead" wires or cables between the point where the same are made to leave any pole for the purpose of entering any building

or other structure, and the point at which they are made to enter such building or structure, nor to any circuit installed for the purpose of leading off or "bucking" from a circuit where it is impracticable to maintain wires otherwise than in a level position; provided, however, that at all times a clearance of not less than two (2) ft. in a vertical direction at point of crossing is maintained between wires or cables carrying at any time more than six hundred volts of electricity and wires or cables carrying less than six hundred volts of electricity; and provided further, that as between any two wires or cables, or any wire or any cable run, placed, erected or maintained in violation of the provisions of this paragraph (c), only the wire or cable last in point of time run, placed or erected shall be held to run, placed, erected or maintained thus in violation of said provision.

(d) Run, place, erect or maintain, any wire or cable which shall conduct or carry at any one time more than six hundred volts of electricity, without causing each crossarm, or such other appliance as may be used in lieu thereof, to which such wire or cable is attached to be kept at all times printed a bright yellow color; or, on such crossarm, or other appliance used in lieu thereof, shall be placed enamelled iron signs, providing, in white letters on a green background, the words "High voltage," and these letters shall be not less than three (3) in. in height, said signs shall be securely fastened on the face and back of each crossarm. The provisions of this paragraph (d) shall not be held to apply to crossarms to which are attached wires or cables carrying or conducting more than ten thousand volts of electricity, and which are situated outside the corporate limits of any town or city which shall have been incorporated as a municipality.

(e) Run, place, erect or maintain any "guy" wire or "guy" cable attached to any pole or appliance to which is attached any wire or cable used to conduct or carry electricity, without causing said "guy" wire or "guy" cable to be effectively insulated at all times at a distance of not less than four (4) feet nor more than eight (8) ft. (measured along the line of said wire or cable) from the upper end thereof, and at a point not less than eight (8) ft. vertically above the ground from the lower end thereof; and further provided, that wherever two or more "guy" wires or "guy" cables are attached to same pole and same anchorage, there shall be at least one (1) ft. vertical space, between the points of attachment; and further provided, that no insulation shall be required at the lower end of a "guy" wire or "guy" cable where the same is attached to a grounded anchor; and further provided, that where guy is attached to a pole or structure of steel or other conducting material, which is thoroughly grounded, no insulation shall be required at any point in said guy; none of the provisions of this paragraph (e) shall be held to apply to "guy" wires or "guy" cables attached to poles carrying no wire or cable other than telephone, telegraph or other "signal" wire or cable, and which are situated outside the corporate limits of any town or city which shall have been incorporated as a municipality.

(f) Run, place, erect or maintain, vertically on any pole, any wire or cable used to conduct or carry electricity, without causing such wire or cable to be at all times wholly encased in casing equal in durability and insulating efficiency to a wooded casing not less than one and one-half (1½) in. thick. The provisions of this paragraph (f) shall not be held to apply to vertical telephone, telegraph or other "signal" wires or cables on poles where no other than such wires or cables are maintained, and which are outside the corporate limits of any town or city which shall have been incorporated as a municipality.

(g) Place, erect or maintain on any pole, or on any crossarm or other appliance on said pole, which carries or upon which is placed an electric arc lamp, any transformer for transforming electric currents.

(h) Run, place, erect or maintain any wire or cable carrying more than fifteen thousand volts of electricity across any wire or cable carrying less than said voltage or across any public highway, railroad right of way, track or line, except on poles which provide at least thirty (30) ft. head room between wire and highway or railroad track, and at least eight (8) ft. clearance above any existing wires under the most unfavorable conditions of temperature and loading; and provided further, that the crossing and adjacent poles shall be guyed thoroughly in all directions of strain, if practicable; and provided further, that the crossing and two adjoining spans shall be erected with the following factors of safety; wires and cables, two (2); pins, two (2); insulators, conductor attachments and guys, three (3); wooden poles and crossarms, eight (8); structural steel, three (3); re-enforced concrete poles, three (3); foundations, two (2); and provided further, that all insulators used on crossing and adjoining spans shall be capable of withstanding a dry flash-over test of three times the normal line voltage for a period of at least five consecutive minutes; and provided further, that the crossing and two adjoining spans shall be constructed so as to be self-supporting in every respect so that failure of any one member will not throw any excessive strain on any other part of the structure; and provided, that where pins are used, they shall be of steel and shall be electrically connected to ground, and that where wooden cross arms are used they shall be provided with a metallic plate on top of same equivalent in conductivity to line conductor; and provided further, that this plate shall be electrically connected to ground, and that all connections to ground shall not be less than the equivalent of number four (4) B and S copper wire.

Section 2. None of the provisions of the preceding section shall be held to apply to "direct current" electric wires or cables having the same polarity, nor to "signal" wires when no more than two (2) of such "signal" wires are attached to any one pole, provided, that none of such "direct current" or "signal" wires shall in any case be run, placed, erected or maintained within the distance of thirteen (13) in. from the center line of any pole (other than the pole or poles on which said wires or cables are carried) carrying electric wires or cables; and provided further, that as between any two wires or cables, or any wire or cable run, placed, erected or maintained in violation of the provisions of this section (2) only the wire or cable last in point of time run, placed, erected or maintained shall be held to be run, placed, erected or maintained thus in violation of said provisions.

Section 3. No commission, officer, agent or employe of the State of California, or of any city and county or city or county or other political subdivision thereof, and no other person, firm or corporation shall run, place, erect or maintain any "span" wire attached to any wire or cable used to conduct or carry electricity, without causing said "span" wire to be at all times effectively insulated between the outer point at which it is in any case fastened to the pole or other structure by which it is hung or supported, and at the point at which it is in any case thus attached, provided, that such insulation shall not in any case be placed less than two (2) ft. nor more than four (4) ft. from said point at which said "span" wire is so attached.

Section 4. Any violation of any provision of this act shall be deemed to be a misdemeanor, and shall be punishable upon conviction by a fine of not exceeding five hundred dollars ($500) or by imprisonment in a county jail not exceeding six (6) months or by both such fine and imprisonment.

Section 5. All acts or parts of acts which are in conflict with the, or with any of the provisions of this act, are hereby repealed.

Section 6. This act shall take effect six (6) months from the date of its passage in so far as it relates to new work, and a period of five (5) years shall be allowed in which to reconstruct all existing work and construction to comply with the provisions of this act.

SPECIFICATIONS FOR OVERHEAD CROSSINGS OF ELECTRIC LIGHT AND POWER LINES.[1]

General Requirements.

1. Scope: These specifications shall apply to overhead electric light and power line crossings (except trolley contact wires), over railroad right-of-way, tracks, or lines of wires; and, further, these specifications shall apply to overhead electric light and power wires of over 5000 volts constant potential, crossing, or constructed over telephone, telegraph or other similar lines.

2. Location: The poles, or towers, supporting the crossing span preferably shall be outside the railroad company's right-of-way.

3. Unusually long crossing spans shall be avoided wherever practicable.

4. The poles, or towers, shall be located as far as practicable from inflammable material or structures.

5. The poles, or towers, supporting the crossing span, and the adjoining span on each side, preferably shall be in a straight line.

6. The wires, or cables, shall cross over telegraph, telephone, and similar wires wherever practicable.

7. Cradles, or overhead bridges, shall not be used.

8. Clearance: The side clearance shall be not less than twelve ft. (12′ 0″) from the nearest rail of main line track, nor less than 6 ft. (6′ 0″) from the nearest rail of sidings. At loading sidings sufficient space shall be left for a driveway.

9. The clear headroom shall be not less than thirty ft. (30′ 0″) above the top of rail under the most unfavorable condition of temperature and loading. For constant potential, direct current circuits, not exceeding 750 volts, when paralleled by trolley contact wires, the clear headroom need not exceed twenty-five ft. (25′ 0″).

10. The clearance of alternating current circuits above any existing wires, under the most unfavorable condition of temperature and loading, shall be not less than eight ft. (8′ 0″) wherever possible. For constant potential, direct current circuits, not exceeding 750 volts, the minimum clearance above telegraph, telephone and similar wires may be two ft. (2′ 0″) with insulated wires and four ft. (4′ 0″) with bare wires.

11. The separation of conductors carrying alternating current, supported by pin insulators, for spans not exceeding 150 ft., shall be not less than:

Line Voltage.	Separation.
Not exceeding 6,600 volts................	14½ inches
Exceeding 6,600 but not exceeding 14,000	24 inches
Exceeding 14,000 but not exceeding 27,000	30 inches
Exceeding 27,000 but not exceeding 35,000	36 inches
Exceeding 35,000 but not exceeding 47,000	45 inches
Exceeding 47,000 but not exceeding 70,000	60 . inches

For spans exceeding 150 feet the pin spacing should be increased, depending upon the length of the span and the sag of the conductors.

Note: This requirement does not apply to wires of the same phase or polarity between which there is no difference of potential.

With constant potential, direct current circuits not exceeding 750 volts, the minimum spacing shall be ten in. (0′ 10″).

[1]Compiled by Joint Committee of National Electric Light Assn, American Institute of Electrical Engineers, American Electrical Railway Assn, Assoc. Railway Tel. Supts, Am. Ry., Eng. & Main. of Way Assn.

12. When supported by insulators of the disc or suspension type, the crossing span and the next adjoining spans shall be dead ended at the poles, or towers, supporting the crossing span, so that at these poles, or towers, the insulators shall be used as strain insulators.

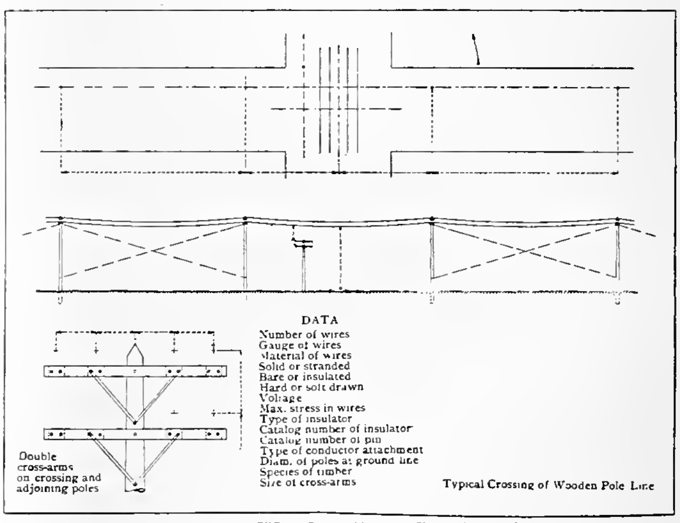
13. The clearance in any direction between the conductors nearest the pole, or tower, and the pole, or tower, shall be not less than:

Line Voltage.	Clearances.
Not exceeding 14,000 volts..............	9 inches
Exceeding 14,000 but not exceeding 27,000	15 inches
Exceeding 27,000 but not exceeding 35,000	18 inches
Exceeding 35,000 but not exceeding 47,000	21 inches
Exceeding 47,000 but not exceeding 70,000	24 inches

14. Conductors: The normal mechanical tension in the conductors generally shall be the same in the crossing span and in the adjoining span on each side, and the difference in length of the crossing and adjoining spans generally shall be not more than fifty per cent of the length of the crossing span.

15. The conductors shall not be spliced in the crossing span nor in the adjoining span on either side.

16. The method of supporting the conductors at the poles, or towers, shall be such as to hold the wires, under maximum loading, to the supporting



Approved Wooden Pole Construction.

structure, in case of shattered insulators or wires broken or burned at an insulator, without allowing an amount of slip which would materially reduce the clearance specified in paragraphs No. 9 and No. 10.

17.—Guys: Wooden poles supporting the crossing span shall be side-guyed in both directions, if practicable, and be head-guyed away from the crossing span. The next adjoining poles shall be head-guyed in both directions. Braces may be used instead of guys.

18. Strain insulators shall be used in guys from wooden poles carrying any power wire of less than 6600 volts. Strain insulators shall not be used in guying steel structures, nor required on wooden poles carrying wires all of which are 6600 volts or more.

19. Clearing: The space around the poles or towers shall be kept free from inflammable material, underbrush and grass.

20. Signs: In the case of railroad crossings, if required by the railroad company, warning signs of an approved design shall be placed on all poles and towers located on the railroad company's right-of-way.

21. Grounding: For voltages over 5000 volts, wooden crossarms, if used, shall be provided with a grounded metallic plate on top of the arm, which shall be not less than one-eighth inch (1/8") in thickness and which shall have a sectional area and conductivity not less than that of the line conductor. Metal pins shall be electrically connected to this ground. Metal poles and metal arms on wooden poles shall be grounded.

22. The electrical conductivity of the ground conductor shall be adjusted to the short-circuit current capacity of the system and shall be not less than that of a No. 4 B. & S. gauge copper wire.

23. Temperature: In the computation of stresses and clearances, and in erection, provision shall be made for a variation in temperature from —29 degrees Fahrenheit to +120 degrees Fahrenheit. A suitable modification in the temperature requirements shall be made for regions in which the above limits would not fairly represent the extreme range of temperature.

24. Inspection: If required by contract, all material and workmanship shall be subject to the inspection of the company crossed; provided that reasonable notice of the intention to make shop inspection shall be given by such company. Defective material shall be rejected, and shall be removed and replaced with suitable material.

25. On the completion of the work, all false work, plant and rubbish, incident to the construction, shall be removed promptly and the site left unobstructed and clean.

26. Drawings: If required, by contract, ... (   ) complete sets of general and detail drawings shall be furnished for approval, before any construction is commenced.

Loads.

27. The conductors shall be considered as uniformly loaded throughout their length, with a load equal to the resultant of the dead load plus the weight of a layer of ice one-half inch (1/2") in thickness, and a wind pressure of 8.0 lb. per square foot on the ice-covered diameter, at a temperature of 0 degrees Fahrenheit.

28. The weight of ice shall be assumed as 57 lb. per cu. ft. (0.033 lb. per cu. in).

29. Insulators, pins and conductor attachments shall be designed to withstand, with the designated factor of safety, the tension in the conductors under the maximum loading.

30. The pole, or towers, shall be designed to withstand, with the designated factor of safety, the combined stresses from their own weight, the wind pressure on the pole, or tower, and the above wire loading on the crossing span and the next adjoining span on each side. The wind pressure on the poles, or towers, shall be assumed at 13 lb. per square foot on the projected area of solid or closed structures, and on one and one-half (1½) times the projected area of latticed structures.

31. The poles, or towers, shall also be designed to withstand the loads specified in paragraph No. 30, combined with the unbalanced tension of:

2 broken wires for poles, or towers, carrying 5 wires or less
3 broken wires for poles, or towers, carrying 6 to 10 wires
4 broken wires for poles, or towers, carrying 11 or more wires

32. Crossarms shall be designed to withstand the loading specified in paragraph No. 30, combined with the unbalanced tension of one wire broken at the farthest from the pole.

33. The poles, or towers, may be permitted a reasonable deflection under the specified loading, provided that such deflection does not reduce the clearances specified in paragraph No. 10 more than 25 per cent or produce stresses in excess of those specified in paragraphs Nos. 65 to 69.

Factors of Safety.

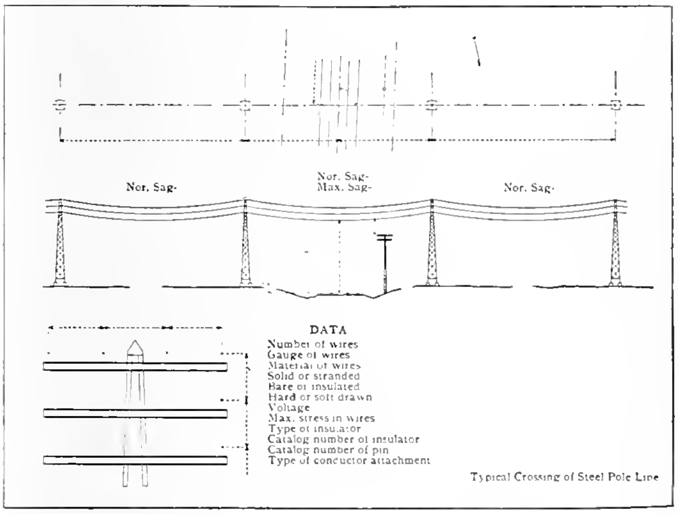
34. The ultimate unit stress divided by the allowable unit stress shall be not less than the following:

Wires and cables	2
Pins	2
Insulators, conductor attachments, guys	3
Wooden poles and crossarms	6
Structural steel	3
Reinforced concrete poles and crossarms	4
Foundations	2

Note.—The use of treated wooden poles and crossarms is recommended. The treatment of wooden poles and crossarms should be by thorough impregnation with preservative by either closed or open-tank process. For poles, except in the case of yellow pine, the treatment need not extend higher than a point two feet above the ground line.

35. Insulators: Insulators for line voltages of less than 9000 shall not flash over at four times the normal working voltage, under a precipitation of water of one-fifth of an in. (1/5") per min., at an inclination of 45 degrees to the axis of the insulator.

36. Each separate part of a built-up insulator,



Approved Steel Pole Line Crossing.

for line voltages over 9000, shall be subjected to the dry flash-over test of that part for five (5) consecutive minutes.

37. Each assembled and cemented insulator shall be subjected to its dry flash-over test for five (5) consecutive minutes.

The dry flash-over test shall be not less than:

Line Voltage.	Test Voltage.
Exceeding 9,000 but not exceeding 14,000	65,000
Exceeding 14,000 but not exceeding 27,000	100,000
Exceeding 27,000 but not exceeding 35,000	125,000
Exceeding 35,000 but not exceeding 47,000	150,000
Exceeding 47,000 but not exceeding 60,000	180,000
Exceeding 60,000	3 times line voltage

Each insulator shall further be so designed that, with excessive potential, failure will first occur by flash-over and not by puncture.

38. Each assembled insulator shall be subjected to a wet flash-over test, under a precipitation of water of one-fifth of an in. (1/5") per min., at an inclination of forty-five degrees (45°) to the axis of the insulator.

The wet flash-over test shall be not less than:

Line Voltage.	Test Voltage.
Exceeding 9,000 but not exceeding 14,000	40,000
Exceeding 14,000 but not exceeding 27,000	60,000
Exceeding 27,000 but not exceeding 35,000	80,000
Exceeding 35,000 but not exceeding 47,000	100,000
Exceeding 47,000 but not exceeding 60,000	120,000
Exceeding 60,000	twice the line voltage

39. Test voltages above 35,000 volts shall be determined by the A. I. E. E. Standard Spark-Gap Method.

40. Test voltages below 35,000 volts shall be determined by transformer ratio.

Material.

41. Conductors: The conductors shall be of copper, aluminum, or other non-corrodible material, except that in exceptionally long spans, where the required mechanical strength cannot be obtained with the above materials, galvanized or copper-covered steel strand may be used.

42. For voltages not exceeding 750 volts, solid or stranded conductors may be used up to and including 4/0 in size; above 4/0 in size, stranded conductors shall be used. For voltages exceeding 750 volts, and not exceeding 5000 volts, solid or stranded conductors may be used up to and including 2/0 in size; above 2/0 in size, conductors shall be stranded. For voltages exceeding 5000 volts, all conductors shall be stranded. Aluminum conductors for all voltages and sizes shall be stranded.

The minimum size of conductors shall be as follows:

No. 6 B. & S. gauge copper for voltages not exceeding 5000 volts.

No. 4 B. & S. gauge copper for voltages exceeding 5000 volts.

No. 1 B. & S. gauge aluminum for all voltages.

43. Insulators: Insulators shall be of porcelain for voltages exceeding 5000 volts.

44. Strain insulators for guys shall have an ultimate strength of not less than twice that of the guy in which placed. Strain insulators shall be so constructed that the guy wires holding the insulator in position will interlock in case of the failure of the insulator.

Strain insulators for guys shall not flash over at four times the maximum line voltage, under a precipitation of water of one-fifth of an in. (1/5") per min., at an inclination of forty-five degrees (45°) to the axis of the insulator.

45. Pins: For voltages of 5000 and over, insulator pins shall be of steel, wrought iron, malleable iron, or other approved metal or alloy, and shall be galvanized, or otherwise protected from corrosion.

46. Guys: Guys shall be galvanized or copper-covered stranded steel cable, not less than 5/16 in. in diameter, or galvanized rolled rods of equivalent tensile strength.

47. Guys to the ground shall connect to a galvanized anchor rod, extending at least one foot above the ground level.

48. The detail of the anchorage shall be definitely shown upon the plans.

49. Wooden Poles: Wooden poles shall be of selected timber, peeled, free from defects which would decrease their strength or durability, not less than seven (7) in. minimum diameter at the top, and meeting the requirements as specified in paragraphs 17, 30, 31 and 34.

50. Concrete: All concrete and concrete material shall be in accordance with the requirements of the Report of the Joint Committee on Concrete and Reinforced Concrete.

Structural Steel.

51. Structural steel shall be in accordance with the Manufacturers' Standard Specifications.

52. The design and workmanship shall be strictly in accordance with first class practice.

53. The form of the frame shall be such that the stresses may be computed with reasonable accuracy, or the strength shall be determined by actual test.

54. The sections used shall permit inspection, cleaning and painting, and shall be free from pockets in which water or dirt can collect.

55. The length of a main compression member shall not exceed 180 times its least radius of gyration. The length of a secondary compression member shall not exceed 220 times its least radius of gyration.

56. The minimum thickness of metal in galvanized structures shall be one-quarter in. (¼") for main members and one-eighth in. (⅛") for secondary members. The minimum thickness of painted material shall be one-quarter in. (¼").

Protective Coatings.

57. All structural steel shall be thoroughly cleaned at the shop and be galvanized, or given one coat of approved paint.

58. Painted Material: All contact surfaces shall be given one (1) coat of paint before assembling.

All painted structural steel shall be given two (2) field coats of an approved paint.

The surface of the metal shall be thoroughly cleaned of all dirt, grease, scale, etc., before painting, and no painting shall be done in freezing or rainy weather.

59. Galvanized Material: Galvanized material shall be in accordance with the Specifications for Galvanizing Iron and Steel.

Bolt holes in galvanized material shall be made before galvanizing.

Foundations.

60. The foundations for steel poles and towers shall be designed to prevent overturning.

The weight of concrete shall be assumed as 140 lb. per cubic foot. In good ground, the weight of "earth" (calculated at 30 degrees from the vertical) shall be assumed as 100 lb. per cubic foot. In swampy ground, special measures shall be taken to prevent uplift of depression.

61. The top of the concrete foundation, or casing, shall be not less than 6 in. (6") above the surface of the ground, nor less than one foot (1') above extreme high water.

62. When located in swampy ground, wooden crossing and next adjoining poles shall be set in barrels of broken stone or gravel, or in broken stone or timber footings.

63. When located in the sides of banks, or when subject to washouts, foundations shall be given additional depth, or be protected by cribbing or riprap.

64. All foundations and pole settings shall be tamped in six-inch (6") layers, while back filling.

Working Unit Stresses.

Obtained by dividing the ultimate breaking strength by the factors of safety given in paragraph No. 34.

65. STRUCTURAL STEEL.

Tension (net section)	18,000	lbs. per sq. in.
Shear	14,000	lbs. per sq. in.
Compression	$18{,}000-60\frac{1}{r}$	lbs. per sq. in.

66. RIVETS, PINS.

Shear	10,000	lbs. per sq. in.
Bearing	20,000	lbs. per sq. in.
Bending	20,000	lbs. per sq. in.

67. BOLTS.

Shear	8,500	lbs. per sq. in.
Bearing	17,000	lbs. per sq. in.
Bending	17,000	lbs. per sq. in.

68. WIRES AND CABLES.

Copper, hard-drawn, solid, B. & S. gauge, 4/0, 3/0, 2/0	25,000 lbs. per sq. in.
Copper, hard-drawn, solid, B. & S. gauge, 1/0	27,500 lbs. per sq. in.
Copper, bard-drawn, solid, B. & S. gauge, No. 1	28,500 lbs. per sq. in.
Copper, hard drawn, solid, B. & S. gauge, No. 2, 4, 6	30,000 lbs. per sq. in.
Copper, soft drawn, solid, B. & S.	17,000 lbs. per sq. in.
Copper, hard-drawn, stranded, B. & S.	30,000 lbs. per sq. in.
Copper, soft-drawn, stranded, B. & S.	17,000 lbs. per sq. in.
Aluminum, bard-dr'n, stranded, B. & S. gauge under 4/0	12,000 lbs. per sq. in.
Aluminum, hard-dr'n, stranded, B. & S. gauge, 4/0 & over	11,500 lbs. per sq. in.

69. UNTREATED LUMBER.

	Bending.	Compression.
Eastern white cedar	600 lbs. per sq. in.	$600\,(1-\frac{L}{60D})$
Chestnut	850 lbs. per sq. in.	850 "
Washington cedar	850 lbs. per sq. in.	850 "
Idaho cedar	850 lbs. per sq. in.	850 "
Port Orford cedar	1150 lbs. per sq. in.	1150 "
Long-leaf yellopw pine	1100 lbs. per sq. in.	1100 "
Short-leaf yellow pine	950 lbs. per sq. in.	950 "
Douglas fir	1000 lbs. per sq. in.	1000 "
White oak	950 lbs. per sq. in.	950 "
Red cedar	700 lbs. per sq. in.	700 "
Bald cypress (heartwood)	800 lbs. per sq. in.	800 "
Redwood	850 lbs. per sq. in.	850 "
Catalpa	500 lbs. per sq. in.	500 "
Juniper	550 lbs. per sq. in.	550 "

L = Length in inches.
D = Least side, or diameter, in inches.

PACIFIC COAST GAS ASSOCIATION.

An appeal is being made to the members of the Pacific Coast Gas Association by John A. Britton, secretary, to increase the present membership from 380 to 500 by the time of the annual convention in San Diego. The convention is to be held September 17, 18 and 19, and from present indications the program being prepared will be among the most profitable and interesting in the history of the association.

WESTERN GOVERNORS OPPOSE CONSERVATION POLICY.

Declaring for state rights and against the conservation policy as now fastened upon the Western states by Federal department heads through their rules, regulations and construction of laws passed with the object of helping settlers, Governor Norris of Montana opened the first annual session of the conference of Western Governors at Boise last week.

The surprise of the opening day's conference was a proposal made by Delos A. Chappell, of Denver, personal representative of Governor Shafroth of Colorado, a big electrical power developer of that state, that the conference of Western Governors and the public lands convention join hands in making the fight for relief from the iron-clad and restrictive rules of the Federal department heads, who are claimed to be Nationalists, and to install a publicity department at Washington for the purpose of having proper relief legislation enacted and the speeches of members of both houses on this measure printed in the records, so they can be distributed among the people for educational purposes along this line. The proposal called for a lively and heated discussion.

Definite action was postponed until later.

In his address, Govenor Norris made a plea for state rights, that the Western people are devoted to the interests of the Nation and of the other states, but feel they may properly exert their best efforts to protect and favor such interests as are of right their own.

"There is a Western theory that all benefits from National resources of right belong to the people of the state wherein the same are situated," said Governor Norris. "The benefits that will be derived will be far greater by the adoption of the Western theory. The first duty of the states is to adopt a policy that is fair and just, and then they may rightfully appeal to Congress to turn over to them the administration of the lands and natural resources belonging to the general Government."

OUTCOME OF WASHINGTON STATE COMPENSATION ACT.

Much interest attaches to the actual working of the Compensation Act of the State of Washington. This act went into effect about a year ago and its principal clauses were commented upon editorially in these columns at the time. The Pacific Builder and Engineer has compiled the following statistics on the operation of this law during the past year:

Workmen's Compensation Act of Washington, after eight months of practical administration, has brought 5200 employers and 125,000 employes under the law.

The expenses have been heavy during these several months, yet this only amounts to 11 per cent of the total funds handled. This includes the expense of office fixtures, books, stationery, etc. All expenses of administering the law are paid by the state and not by the listed industries.

Up to June 1, 1912, approximately $700,000 had been contributed by the hazardous industries to the accident fund and approximately $377,000 has been paid out by the commission to injured men in cash and invested in bonds to insure pensions to workmen's widows and orphans. Municipal, county and school district bonds are purchased for this purpose, thereby retaining large sums of money in the state, that would otherwise largely pass to the east through casualty companies. In this connection it has been shown that, notwithstanding the amount of money paid to workmen in compensation, the cost to employers in many cases is less than casualty insurance. This is illustrated by class 10, lumber mills and loggers, where the cost last year for casualty insurance was $1.35 to $1.50 per thousand. So far it has cast the employers under the Compensation Act but 62½ cents per thousand.

Out of 5200 employers subject to the law only 33 have failed to pay on demand, and of these 14 cases have been settled by the attorney-general's office. Of the remaining 19 many are in process of adjustment. Very few of those in default have shown any intention of going into court. Out of 5666 claims passed upon but 12 appeals have been filed.

There is a decided move on to have a first aid clause added to the act. This is due to the fact that at present costs of necessary medical, surgical and hospital service are added to the claimant's wage-loss.

LECTURE ON ILLUMINATION.

W. D'A. Ryan, illuminating engineer with the General Electric Company, will give a lecture on "The History of Illumination," in the colonial ballroom of the St. Francis Hotel, San Francisco, at 8 o'clock on Friday evening, August 16. All electrical men are invited to attend.

WESTERN LAWS OF ELECTRICITY AND WATER

IRRIGATION DISTRICTS.

BY A. E. CHANDLER.

Legislation for the formation of districts for flood protection, drainage and roads was long ago adopted in both the Eastern and Western states. Such acts secure for a community the benefits of protective or public improvement works through taxation, even though a minority of the property holders object. As the appreciation of the results of irrigation in the interior valleys of California spread during the eighties and as the obstacle in the way of community enterprises of the old partnership or ordinary corporation type seemed to be the larger ranchers who opposed the movement, the compulsory district organization was suggested. The first irrigation district act was adopted by the California legislature in 1887 and has since been generally known as the Wright Act, as State Senator C. C. Wright was the most prominent champion of the measure.

The California Irrigation District Act.

The California irrigation district act as amended and supplemented, was re-enacted in 1897 and is locally known as the Bridgford Act. Statutes very closely following those of California have been adopted in every irrigation state with the exception of Arizona (bill pending in legislature May 1, 1912), the Dakotas and Oklahoma.

The following presentation of the provisions of the irrigation district act is for the Bridgford Act of California, but it will serve as a general statement for such legislation in the other states as the points of difference are but few.

An irrigation district is initiated by a petition to the Board of Supervisors signed by "a majority in number of the holders of title to lands susceptible of irrigation from the proposed source and representing a majority in value of said lands." The petition must be published for two weeks and be presented at a regular meeting of the board, at which time a hearing is given to all those interested. If the action of the board is favorable it defines the boundaries and divides the proposed district into three or five divisions. Any party aggrieved by the action of the board may appeal to the Superior Court.

After favorable action by the board a date is set for an election on district organization, the notice for which must be published for three weeks. All qualified electors within the district may vote upon the organization and at the same time vote for the three or five directors, an assessor, a tax collector, and a treasurer. Two-thirds of all votes cast must be for the formation of the district in order to carry it. If the vote be favorable the board of directors so elected has control of the district business, causes surveys and plans of the irrigation system to be made and, after petition so to do, causes a bond election to be held. At this election a majority of the votes cast is necessary to carry the bond issue. The bonds bear interest at the rate of five per cent, are payable from the twenty-first to the thirtieth year and must be sold at not less than par.

The interest on the bonds and the operation and maintenance expenses of the district are paid by taxing all lands within the district on an ad valorem basis. The act specifically provides for the sale of property for non-payment of taxes as in the case of non-payment of state or county taxes.

Several amendments to the district act were passed at the regular and special sessions of the California legislature in 1911. The aim of all of the amendments was to secure a better financial basis for the sale of the district bonds. The principal act provides for a detailed examination of the feasibility of the districts by a commission, composed of the Attorney General, the State Engineer and the Superintendent of Banks, when called upon to do so by the district board of directors. When the commission approves the feasibility of any district project, the bonds of the district may be registered at the office of the State Controller and thereupon shall be considered legal investments for all trust funds and for funds of insurance companies, banks, etc., and are in general placed upon the same legal basis for purposes of investment as the bonds of cities and counties, school districts, or municipalities.

Points of Difference in Irrigation District Acts.

The principal points of difference in the various state statutes providing for irrigation districts are the provisions regarding state supervision; the exclusion of land included in the original petition; the qualifications of voters; the rate of interest on bonds and the authority to sell bonds below par; and the basis of assessment.

In Idaho, Oregon and Wyoming, the feasibility of the project must be approved by the state engineer. The operations under the acts in Oregon and Wyoming are just beginning but a number of districts have been operated successfully for many years in Idaho. In the latter state the original petition to the board of county commissioners must be accompanied by a map of the proposed district. The petition and map are referred to the state engineer for report and if his report be against the organization of the district the county commissioners must refuse to further consider the petition unless it be requested in writing so to do by three-fourths of the landowners in said proposed district. The plans and specifications for the proposed system prepared after the formation of the district, must also be reported upon by the state engineer, but it is not provided that such plans must be changed in order to secure his approval.

In the California act it is provided that the board of supervisors shall not allow to be included in the proposed district any lands which will not, in its judgment, be benefitted by the proposed means of irrigation. This provision is the general one, but in Wyoming it is provided, "nor shall any land be included in

such district if the owner thereof shall make application at such hearing to withdraw the same." In Oregon no land can be included in the district which lies within the limits of any city or town. In Colorado and Wyoming it is provided that no land shall be taxed for irrigation purposes "which from any natural cause cannot be irrigated, or is incapable of cultivation."

In California any elector residing within the district has the right to vote regardless of property qualifications—it being generally understood that to place limitations upon the right to vote would render the section unconstitutional. In Colorado and Idaho the voters must be resident freeholders, and the Oregon statute provides that a bona fide owner of land, whether a resident or not, may vote.

The rate of bond interest varies from five per cent in California to seven per cent in Idaho, and a number of states allow bonds to be sold at not less than ninety per cent of par value.

The basis for assesssment in California is the full cash value of the property. In Idaho the assessment is made in accordance with the benefits received as determined by the board of directors. In Colorado and Wyoming all lands within the district for the purposes of taxation must be valued by the assessor at the same rate per acre. This last method is analogous to that used by the ordinary irrigation companies in charging a fixed rate per acre.

The Constitutionality of Irrigation District Acts.

Owing to the compulsory nature of the irrigation district enterprise, it was to be expected that litigation should be initiated immediately after the formation of the first California districts by the landowners whose lands had been included against their wish. The validity of the act was assailed on every possible ground but was upheld by the Supreme Court of California and finally, in the celebrated case of Fallbrook Irrigation District v. Bradley (164 U. S. 112), by the Supreme Court of the United States. Extensive litigation has followed the inauguration of irrigation districts in other states but the validity of the several acts has likewise been upheld. There seems to be no question, therefore, that the many provisions of the irrigation district acts are legally sound.

The report of the case of Fallbrook Irrigation v. Bradley is interesting not only for the opinion by the court, but also for the argument against the validity of the act given by Joseph H. Choate, who in his argument presents the view of a great number of Californians at that time in regard to the questionable novel features of the act. The following extract from Mr. Choate's argument shows what he thought of the new system:

This brings into view the unique and, as we believe, wholly unprecedented features of the scheme contrived by this act for the oppression of the farmers of California. We think that the statute books of all states and nations outside of California, prior to 1887, will be searched in vain, without finding another such example, and especially in view of the construction which has been given to certain details of this statute by the Supreme Court of California.

Operations Under Irrigation District Acts.

Although thirteen irrigation states have irrigation district acts, only eight had irrigation district enterprises irrigating land in 1909, and only nine had projects either completed or under construction in 1910. The following table taken from the advance sheets of the Thirteenth Census shows by states the acreage irrigated by irrigation district canals in 1909, and also the acreage included within districts completed or under construction in 1910.

State.	Acreage Irrigated in 1909, by Irrigation Districts.	Acreage Irrigation Districts were capable of irrigating in 1910.
California	173,793	606,351
Colorado	115,304	487,370
Idaho	140,930	329,796
Montana	4,912	15,040
Nebraska	76,448	91,076
Oregon	1,500	5,980
Utah	8,455	10,802
Wyoming	11,800	27,050

A glance at the above table shows that there has been little irrigation district development outside of California, Colorado, Idaho and Nebraska and that such development has been most pronounced in the three states first named.

Irrigation Districts in California.

The Irrigation Investigations of the United States Department of Agriculture has gathered data for the publication of a report on irrigation districts in California. Certain statistical information from the proposed report was presented in a paper read by Mr. Frank Adams, in charge in California, before the Commonwealth Club of California. On account of the growing interest in the history of California districts, the following long quotation is made from Mr. Adams' paper:

Forty-nine districts were organized, and of these only 25 ever issued any bonds.

The statement that practically all of the 49 defaulted in large amounts should therefore be reduced one-half.

Of the 24 districts that issued no bonds, none at this time has any outstanding indebtedness. Eleven have been legally dissolved. Twelve have not been dissolved, although they are not active. One, the Walnut Irrigation District, covering about 900 acres of land in Los Angeles County, near Whittier, has been active and successful from the date of its organization and has never defaulted in any way in payment of indebtedness.

Of the 25 that issued bonds, 7 have made some kind of a settlement and have no outstanding obligations as districts at this time. Two have made settlement, but still have small outstanding indebtedness that either has been declared illegal or can not be found. Four have made settlement by exchanging new for old bonds and are now active, and with the exception of one, whose reorganization is not yet complete and which therefore cannot be judged, are active and successful and can undoubtedly be counted on to pay both bonds and interest as due. Five have compromise settlements pending. Seven have apparently been totally abandoned, with no plan of settlement as yet seriously taken up.

Where settlements have been made they have been so different that it is hard to explain them with sufficient brevity for the purpose of this paper, and reference is therefore made to the table that will be submitted. The lowest basis of settlement has been 30 cents on the dollar, and the highest between 80 cents and 90 cents. Several compromised at 50 cents.

Of the 7 districts that apparently have been totally abandoned, and for which no plans of settlement have yet been seriously taken up, at least 3 were wildcat land-promotion schemes, pure and simple, and although reported favorably by engineers of reputation, apparently never had engineering justification, chiefly due to lack of water. The outlook for them is not encouraging, although in time they will without question be cleared up in some way. This might also be said of the other four.

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POWER AND GAS

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

A Conservation Committee

Representatives of the hydroelectric interests in California met recently for the purpose of selecting a committee to sit for these interests at a water power conference to be held at an early date. The session will be called by Secretary Fisher of the Department of the Interior. Representatives from the Geological Survey, the Forest Service, Department of Agriculture, the Bureau of Corporations, and the California Water Commission have also been invited to attend.

It is most opportune that such a meeting, composed of parties at issue in the present hydroelectric disputes should be called at this time. The commissioner of corporations, some time since, made a report to President Taft relative to the present ownership of water powers, developed and undeveloped, in the United States. California, of all Western states, is at present in the highest state of hydroelectric development. With but one single exception this state according to the commissioner's report presents the greatest future hydroelectric possibilities of any state in the union. With a possible minimum of 3,424,000 h.p. in total water power, and a present development of 435,467 h.p., California stands in the limelight as a state of utmost interest to those following affairs electrical.

The fact that eight large corporate interests or even one large corporate interest seems to control at present the hydroelectric power of the United States is not in itself a cause for alarm. Hydroelectric enterprises, commission controlled, may be made of utmost service to this generation and to the solution of our present economic problems without calling for one foot-pound of wasted energy in our national resources, for like the widow's cruse of oil, the eternal waterfall, used over and over again, blesses mankind with its store of light and warmth without the slightest lessening in supply. On the other hand, that loud-sounding cry of conservation which would put off to another age and generation powers so dearly needed in our present industrial era, leads but to stagnation in national industry and even possibly to a blighting in national growth in a new and promising community.

The alert and emphatic action of Western governors in convention assembled, an account of which is found elsewhere in these columns, bespeaks the spirit of the West. Hence the result of the forthcoming conference will be watched by all with the keenest interest.

Safeguarding the Children

The horrifying crushing of children under street cars, one in San Francisco and the other in Seattle, of late, has once again aroused public discussion as to means of prevention or at least the minimizing of such distressing accidents.

Much good can be accomplished by public safety committees in the various cities of the coast. First, an investigation as to how the accidents most frequently occur and then a widespread campaign of education among the children and parents emphasizing methods of accident prevention will do worlds of

good. In the East, the Philadelphia Rapid Transit Company deserves much credit for the efficient manner in which they have conducted their accident prevention crusade. On another page of this issue will be found a digest of the rules and warnings that have been formulated. These printed in attractive form have been distributed by the thousands to parents and children through the courtesy of the city board of education.

The influence of the home is the most powerful force that can be brought to bear upon the children. Co-operation between the parents, a permanent public safety committee, and the traction officials will in every case, we believe, reduce to a minimum such frightful accidents as above alluded to that happened recently in San Francisco in which a youngster strayed out into the middle of the street, became oblivious to its surroundings, only to be crushed to an unrecognizable mass a few minutes later almost within the sight of the mother.

It is an excellent discipline in life to be alert, to learn to heed warnings, to resist the temptation of examining fallen or dangling wires, to have patience until the car stops, to avoid dangerous places while roller skating. Such are some of the important findings in Philadelphia, and their shunning, we believe, will be found just as wholesome in effects in the West as in the East. Other factors peculiar to western habits and western life undoubtedly contribute to the loss of life and injury to the children of the West. It is to be hoped that our public spirited traction officials of the West will study out these problems with vim and vigor at once, not waiting for the demand to come from the public themselves. By such zealous, ever-active methods a wholesome grateful spirit is imbued in the hearts of the public that can be brought about in no other way.

Proposed Law on Overhead Construction

No one law affecting public utilities has seemingly brought about as much dissatisfaction and divergence of opinion in regard to carrying out its mandates as does the present California law on overhead crossings which went into effect some months back. By reading the list of some of the objections to this law, appearing on another page of this issue, and compiled by serious, earnest, engineering thinkers interested, no one can for a moment come to any other conclusion but that the present law is unjust, inconsistent, vague, and often meaningless.

Indeed, so convinced are those affected by this law that its present provisions are thoroughly inadequate and wholly misdirected, a state-wide protest has arisen to have the law properly amended. The provisions as to overhead crossings are so foolishly far from accomplishing a useful purpose that they might to one discussing lighter subjects, be technically termed "a joke."

The question of proper construction in overhead crossings is not an easy one of solution. So frequently does the march of progress and invention bring about better material and more safe methods of construction, it is doubtful if any law can be made to adequately express proper specifications for all time to come.

The whole subject is one that has attracted the profoundest attention of our largest and most learned technical societies. On another page of this issue is to be found the specifications for overhead crossings of electric light and power lines compiled by joint committees of the five great electrical societies of America—the National Electric Light Association, the American Institute of Electrical Engineers, the American Electric Railway Association, the Association of Railway Telegraph Superintendents, and the American Railway Engineering and Maintenance of Way Association.

Let us for a moment examine the new California Public Utilities Act. In Sec. 44, under the heading Investigation of Accidents, there appears the following mandate:

"The commission shall investigate the cause of all accidents occurring within this state upon the property of any public utility or directly or indirectly arising from or connected with its maintenance or operation, resulting in loss of life or injury to person or property and requiring, in the judgment of the commission, investigation by it, and shall have power to make such order and recommendation thereto as in its judgment may seem just and reasonable."

We maintain that even though the public utility companies of California live up to the mandates of the law in question, even then, the commission may direct improvements and alterations as in their judgment are demanded for public safety to life and property. Indeed it is questionable whether this clause does not of itself repeal the law at issue, for under Sec. 87 of the Public Utilities Act, we find that "all acts or parts of acts inconsistent with the provisions of this act, are hereby repealed."

We would suggest, then, since a new law to amply express the provisions of overhead construction and other mandates involved in the present law, must of necessity be long and cumbersome, besprinkled with many illustrations; since these provisions, due to the march and progress of invention, are constantly changing; and, furthermore, since the present Railroad Commission, acting under the new Public Utilities Act, has authority to go even further than this act and, in fact, may even have complete authority in preference to the present law on overhead construction, that in order to settle all discussion and doubts in the matter a new law be framed in the nature of an amendment to the Public Utilities Act. The amendment may easily be brought about by properly substituting the word "public utility" for the word "railroad" in section six of Section 43 of the Public Utilities Act. In this manner, the commission will be given exclusive power to determine and prescribe the manner and the terms of installation, operation, maintenance, use and protection of each crossing of public utilities either over railroads or the public highways Of course such provisions may be added in this amendment that the rules laid down must conform as nearly as is practicable to the findings of the National engineering societies. Thus will easily be settled a question which at present involves much obscurity and at the same time an elasticity is given to take advantage of the march and progress of invention. On the other hand, since the commission is directed to cling as nearly as is reasonable to the specifications of the great national engineering societies, the public utility companies are protected from the possible whim and caprice of a future regulating commission.

PERSONALS.

C. L. Cory recently returned to San Francisco from Spokane, Wash.

Walter Trent, head of the Trent Engineering Company, of Reno, is a San Francisco visitor.

E. H. Grange, an electrical contractor of Upland, is among the recent arrivals at San Francisco.

Leon M. Hall who is engineer for several new hydroelectric projects, spent the past week at Virginia City, Nev.

J. B. Lukes, of the Stone & Webster Construction Company's San Francisco office, visited Reno during the week.

J. B. Lippincott, hydraulic engineer on the Los Angeles Aqueduct, recently visited at San Francisco from the South.

Cyrus Peirce, San Francisco manager for N. W. Halsey & Co., who are extensive holders of California electrical securities, returned during the week from an extensive automobile tour after enjoying the fishing in Northern California.

Elmer Dover, president of the Tacoma Gas Company, of Tacoma, Wash., was at San Francisco during the past week, conferring with C. E. Groesbeck of H. M. Byllesby & Company.

R. L. Van der Naillen, general manager of the Oro Electric Corporation, recently returned to San Francisco, after visiting the power site of the company's proposed hydroelectric development on Yellow Creek.

F. A. Richards, manager of the railway department of Pierson, Roeding & Company, is at Vancouver, B. C., on business.

F. O. Broili, manager of the Nevada Machinery and Electric Company, of Reno, Nev., is a recent San Francisco visitor.

F. Emerson Hoar is now connected with the California Railroad Commission as an electrical expert, specializing on rate matters.

J. S. Baker, district manager for the Crocker-Wheeler Company, is again at his office, after having been confined to his home by illness.

E. B. Bumstead, of the Pacific Coast engineering staff, left last Wednesday on an Eastern trip for the Stone & Webster Engineering Corporation.

H. A. Hinshaw, assistant general manager of the Salem, Falls City & Western Railroad, which extends between Dallas and Falls City, Oregon, is a San Francisco visitor.

Harry H. Daley, sales engineer with the Westinghouse Electric and Manufacturing Company's San Francisco office, was an interested spectator at the Salinas "rodeo."

A. W. Bullard, vice-president of the Great Western Power Company, has returned to San Francisco after an inspection of the work in progress on the Big Meadows dam.

C. E. S. Forney, who is interested in a combination of gas companies covering Hanford, Lemoore and various San Joaquin Valley towns, was a recent San Francisco visitor.

J. Tachihara, an official of the Mitsu Bishi Dockyard and Engine Works at Kobe, Japan, has been visiting electric power and engineering plants at San Francisco and near-by points.

G. D. Sherwood, who has extensive electric power and water works interests at Spokane, Wash., was at San Francisco during the week and later went to the Bohemian Grove to witness the jinks.

F. E. Vickers of the engineering department of the General Electric Company's San Francisco office, has been appointed turbine inspector for the district. **John Hood** is now the company's local engineer.

J. A. McMonnies, who is at the head of the appliance department just opened by the Great Western Power Company, will leave shortly on an extensive Eastern tour, in the course of which he will secure valuable information in his lines.

A. J. Bowie Jr. is visiting Southern California for the purpose of supervising the preparations for installing a number of 150,000-volt Bowie switches on the new transmission lines of the Southern Sierras Power Company, which are being built by Manifold & Poole, engineers.

George C. Holberton, district manager of the Pacific Gas & Electric Company at San Francisco, recently acted as host to a party of prominent Chinese, including General Lan Tin Wei. After the visitors had inspected several of the company's electric stations they were entertained at a luncheon. On the same afternoon the party made an automobile tour of the east shore of the bay as guests of Traffic Manager Keith of the Oakland Traction Consolidated system.

Electrical men attending the Bohemian Club high jinks at Bohemian Grove, California, this week include **John A. Britton,** vice president and general manager of the Pacific Gas and Electric Company; **Chas. N. Black,** vice president of the United Railroads; **W. D'A. Ryan,** illuminating engineer with the General Electric Company; **G. L. Bayley,** chief mechanical and electrical engineer for the Panama-Pacific Exposition; **Wynn Meredith** and **R. S. Buck,** of Sanderson & Porter; **A. M. Hunt,** consulting engineer; **C. L. Cory,** consulting engineer.

JOVIAN LUNCH CLUB, SAN FRANCISCO.

A large and enthusiastic meeting of the Rejuvenated Sons of Jove was held at noon on August 6th obedient to the call of T. E. Bibbins, statesman-at-large. A general discussion was held regarding the feasibility of holding a weekly lunch, a committee consisting of C. F. Butte, R. M. Alvord and A. H. Halloran being appointed to report at a lunch on August 20th.

REPORT OF INTERNATIONAL CONGRESS COMMITTEE.

Your Executive Committee takes this occasion to report progress in negotiations with the Panama-Pacific International Exposition Company in regard to the 1915 International Electrical Congress. Through the energetic efforts of Vice-President Lardner, we have been officially advised by the officials of the Exposition Company that suitable auditoriums and other facilities will be made available for our purpose during the week beginning September 13, 1915. The status of Exposition plans is not yet such as to permit specific assignments, but we are assured that our interests are properly safeguarded and that the Exposition authorities will do everything possible to make certain the success of the Congress in so far as it may lie within their power.

Tentatively the following list of Sections has been prepared in order to assist in considering plans for Congress organization and program:

1.—Lighting and Illumination, including Electric Lighting of all kinds, electric radiation, etc.

2.—Generation, Transmission and Distribution, including hydroelectric plants, steam stations, transformers, substations, etc.

3.—Electric Traction and Transportation, including propulsion and electric vehicles.

4.—Electric Power, including the application of electric motors to industrial purposes.

5.—Economics, including load factors, power factors, and all problems affecting the economy of electric distribution, also regulation by Public Service Commissions, etc.

6.—Machinery, Transformers and appliances.

7.—Telegraphy and Telephony, including all communication and signalling by wires.

8.—Wireless Telegraphy and Telephony, including all communication by electromagnetic waves without wires.

9.—Electro-chemistry and Electro-metallurgy, including electric furnaces.

10.—Electric Measurements and Instruments.

11.—Protective devices and Transient and High Voltage Phenomena.

12.—Miscellaneous.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

METHODS OF ESTIMATING.

BY W. S. HANBRIDGE.

In speaking of our recent trip to Denver to attend the National Electrical Contractors' Association Convention, if I were asked to put the entire proceedings into as few words as possible, I would say:

Co-operation to improve quality and service and education of the electrical contractor to be just to himself and to the consumer. Quality and service I feel can be handled together and I would say that some could divided as follows:

First—to cut out personal likings in purchasing stock which the consumer wants. Second—To buy nothing you can't sell at a profit. To cut out estimating for people who refuse to let you make a profit and to conserve your time by cutting out unneccessary estimating. Third—To turn your stock over as often as possible. Fourth—To give full and exact measure—no more, or no less—at each transaction. Fifth—To know your cost and what makes them and to cut them as low as possible without sacrificing quality and service to the consumer and justice to yourself.

To follow up the above, taking the first section—how often does an architect specify a certain kind of switch, and how much time do you consume telling him that something else is just as good? Don't you think it would please him more if you gave him what he wanted, instead of telling him that you buy the other kind in large quantities and that it would cost you a few cents more to give him what he wants? You may get him to grudgingly allow you to use what you want but I think that he would be much better satisfied if you gave him what he asked for. There are many things that a contractor spends more money and time trying to substitute than the difference in the cost of the article which is specified against the article substituted and then again often the article substituted is inferior to the article specified. My suggestion is to stop substituting. Give your customers what they ask for, and stop letting genial salesmen tell you what your customers need, but let the customers do the specifying and you give them the service by supplying them with what they want.

When a customer has no preference sell them the very best the market affords, therefore, educating them to a high standard, which means more profit for you and a very much satisfied customer.

Second—To buy nothing that you cannot sell at a profit. Summed up, means cut out unnecessary purchasing—unneccessary estimating and conserve your time so that it can be turned into more profitable channels. In other words I would say analyze your needs carefully, don't be so anxious to tie up your money and credit every time a salesman offers you an additional 10 per cent on any article, before purchasing make sure of two things—first, can I turn it over soon enough to pay me for tying my money and credit up, and second and most important—am I really saving any money?

In these busy times some people have a notion that they are making money by buying cheaply and these same people think that at any time they can get an article 5 or 10 per cent cheaper than the market price, that they are making money and they lose all sight of the fact that often the quality is not there, that depreciation and interest on the investment often make a cheap article expensive by the time it is turned over, and last, but not least, often Mr. Shrewd Buyer ties up his money or credit in such a manner that his assets are really the stock on his shelves, which in a pinch are worth considerably less than either the cash or his credit.

In reference to reckless estimating analyze the people to whom you are sending your estimates, remember it costs money to prepare a proposal. If a man accepts your proposal he usually expects you to live up to it to the letter; so, therefore, why should you not enter into a contract with him before you give him a proposal. You giving your time and money to prepare a careful estimate; he giving you an absolute square deal. Agreeing not to "peddle," and if you are the lowest bidder, give you the job. I would say cut out all who do not give you this treatment.

Third—Turn your stock over as soon as possible; now if you can buy an article today, put it in the job tomorrow, collect for it the next day, pay your jobber the next day, you would have reached the highest point of efficiency known in the business world, but as this is impracticable, I would say, buy only what you need, install and bill as promptly as possible, get a reputation for collecting promptly and also a reputation for paying your bills promptly. I think that if the average contractor would observe these four rules they would make more money than by trying to beat the game by quantity purchases, which usually lay on shelves a long time.

Fourth—To give full and exact measure, no more, no less; it is a big subject and could be covered in a paper by itself, but I would say to the electrical contractor, figure your plans and specifications carefully and honestly make notes of what you know to be technical errors, and do not sign up a job until you have a thorough understanding in writing of every one of the technical errors.

In making the above statement I do not deem it necessary for the electrical contractor to have second sight and take care of things that architect and owner have not thought of, but I do think that when a man calls in an electrical contractor for an honest estimate he is entitled to such suggestions that will give him a perfect job of wiring covering the results specified.

In reference to additions to plans and specifications. After having a perfect understanding the electrical contractor is entitled to an extra for everything added and the owner is entitled to nothing which is not specified. On all extra work there should be added a reasonably fair profit. A contractor must be just to himself and he must be fair to his customer, and the evils that exist in billing extra work has caused a loss of more customers than any other known evil. I personally believe that an extra is nothing more than part of a contract and that a contractor is entitled to the same profit as his original contract allowed him, of course, speaking now, that he has been fair with himself in figuring the original contract. But to the contractor who takes contracts at a low margin of profit in order to get the extra work, I will say that I believe that some day a bright attorney will spring the defense in some of our courts, that a man is entitled to no more profit on his extras than he originally asked for on his contract, and I feel that a judge in rendering a decision along that line would do so on the grounds that the contractor had established his own price.

It is absolutely necessary at all times to keep customers satisfied as it is much easier to lose a customer than gain a new one, so by being consistent in your charges, rendering good services, keep the quality up to standard, you will gain the confidence of your customer.

Fifth—To know your costs and what makes them. I am not going to enter into this subject as it will surely be covered today, but to emphasize what will be stated later, that knowledge is power, can never be illustrated any better than in the above clause. Know your costs and what makes them, gives you the power that is necessary to do a thing because it is right and remember only those things live

which are based on right, viz: You may have a perfect working organization, your secretary may be able to tell each one of you what is the right thing to do and even by pressure make you add enough profit so that you cannot lose money, but it will only live and grow stronger when it stands out in the minds of each member braced on all sides by a perfect knowledge of costs, then each member will be a support unto himself and will do things because he has the knowledge that if he does otherwise he will hurt himself, and leaving out the gambler's chance, no man will do anything knowingly which will injure himself.

When you have learned your own cost do not be afraid to help your competitor learn his cost; by doing so you are helping yourself as well as he, and furthermore, to the man who knows his cost and of what they are composed, he approaches a prospective customer with that confidence that gives the customer confidence in him and when you have obtained the confidence of a prospective customer, half the battle is won. To my mind it does not require the art of salesmanship to land business for an electrical contractor, but it does require a broad-gauged man, who has confidence in every statement he makes; first, because he knows his business as an electrician; second, because he knows the elements of his business and of what they are composed and the result is when he tells a prospective customer that a job will cost a certain amount, he has cut out all chances of argument and therefore, is not an easy prey to the shopper or "peddler," but is ready to advance arguments of quality and service in place of reducing prices.

In concluding I would say that if the first paragraph, or if you will allow me to repeat, co-operation to improve quality and service and education of the electrical contractor to be just to himself and the consumer, were made the matter of this organization, and if each and every one of us would jot it down on our calendars, keep it ever before us, boost it where and whenever we could, the time would not be far distant when it would be considered an honor and not a duty to belong to the California State Association of Electrical Contractors.

The following numbers won gate prizes at the Electrical Trades picnic and have not been claimed: No. 181, an electric portable lamp stand; No. 512, a toaster; No. 216, an electric portable lamp stand. Parties having above tickets can get prizes at Room 1408 Merchants National Bank building.

TRADE NOTES.

J. A. Barker is in charge of the construction of the Pacific Gas & Electric Company's new substation at Woodland. The last of the concrete for the structure has been poured and the machinery will be installed in the near future. Current will be supplied from this station to the Vallejo & Northern Railroad Company, of which T. T. C. Gregory is president.

The Pelton Water Wheel Company has been awarded a contract by the Southern Sierras Power Company for installation at Power House No. 3, one Pelton tangential water wheel which is to develop 2850 h.p. under a head of 290 ft. at 164 r.p.m. A water wheel for an exciter set is also included in the contract. An Allis-Chalmers generator will be direct-connected to the water wheel.

The Allis-Chalmers Company recently sold the Hammond Lumber Company complete steam-driven electric equipment for its new wood-working plant at Los Angeles. The apparatus contracted for includes: One 24 x 42 in. Corliss engine, directed connected to a 575-kw. alternating-current generator, and a number of induction motors aggregating 900 h.p., complete with exciter and switchboard. A large sash and door factory and a planing mill will be electrically operated.

The Pacific Light & Power Company, which recently contracted with the Allis-Chalmers Company for four large impulse water wheels for the Big Creek development, has issued specifications for the steel pressure pipe lines for four generating units. Fully six million pounds of steel will be used in the construction of four lines of about 4400 feet each. There will be several sizes of pipe running from 84 in. down to 24 in. There will be a drop of 1960 feet in the pipe lines leading down to the two power houses that are being installed at a point about 70 miles from Fresno. It is reported that the General Electric and Westinghouse electrical apparatus will be installed.

NEW CATALOGUES.

Sprague Electric Grab Bucket Cranes are illustrated and described in Bulletin No. 902 from the Sprague Electric Works. These machines "can shovel, lift, convey, deposit and pile" and are equipped with a simple, fool-proof control.

Bulletin No. 149 from the Crocker-Wheeler Company, is devoted to Form H Direct Current Motors and Generators. These motors are for 50 h.p. and more and are provided with commutating poles so as to be sparkless without shifting the brushes.

Engineering Data on Modern Illumination is the subject matter of Handbook No. 409 from H. W. Johns-Manville Company, a lose-leaf binder containing tables, diagrams, illustrations and facts on the application of Frink reflectors and J.-M. Linolite system to industrial lighting problems. Catalogue No. 410 from the same company is devoted to Modern Store Illumination and contains many illustrations of reflectors and lamps.

The Westinghouse Electric and Manufacturing Company is issuing a series of descriptive leaflets on the application of electric motors to paper mill service. No. 3505 just issued covers their application to Jordans. Circular 1516, attractively bound in an art cover, is devoted to electric locomotives, as built by the Westinghouse Company jointly with the Baldwin Locomotive Company of Philadelphia. This publication discusses the field of application of the electric locomotives to both steam and electric railways and shows numerous applications on roads throughout the country.

The Westinghouse Electric & Manufacturing Company has just issued a series of Descriptive Leaflets (Nos. 2465 to 2473) illustrating the new line of switchboard seven and nine-inch indicating meters. No. 2494 fully illustrates and describes the Westinghouse Synchronous Booster Rotary Converter. This machine consists of a standard converter in combination with a revolving armature alternating current generator mounted on the same shaft with and having the same number of poles as the ammeter by means of which the direct current voltage delivered may be varied. Commutating Pole Direct Current Motors (Type QM) for compressors, blowers, pumps and similar classes of service are fully illustrated and described in leaflet 2499.

THE KELLOGG HOWLER.

Telephone companies are oftentimes annoyed by subscribers leaving the receivers off the hook—time is lost and the service is more or less impaired. The Kellogg Switchboard & Supply Company has recently issued a four-page folder descriptive of their "howler" equipment which is effectively used in remedying this evil.

"Receiver off! Don't send a man," reads the front cover. "Have a Kellogg Howler to signal your subscribers who leave their receivers off hooks." In addition to this description on the cover is an illustration of a wire chief at his desk (just about to work the "howler"). Below this is shown the absent-minded subscriber reading his paper and—the receiver off the hook.

On the second page is a halftone illustration of the simple apparatus necessary. Pages two and three are given over to description. Kellogg extra heavy moisture-proof cords are mentioned on the fourth page. The type matter, border rules and illustrations are printed in brown ink and the booklet is a forceful sales argument.

INDUSTRIAL

POWERFACTOR METERS.

A poor powerfactor can often be improved by a better proportioning of the motors to their load, the use of a super-excited synchronous motor or similar means, with resulting increased capacity and efficiency of the system. It is therefore important, particularly in heavily loaded plants, to know what the actual powerfactor is at various conditions of load. To do this, it is not necessary, as it once was, to

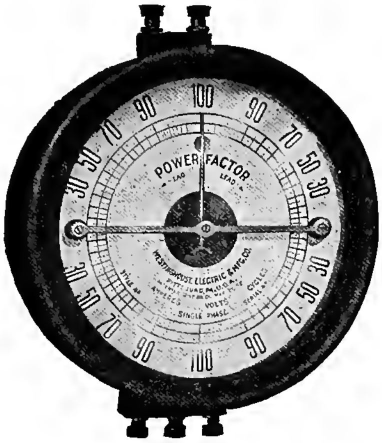


Fig. 1—7-inch Power Factor Meters.

take readings of voltage, current and power and to calculate from these the ratio of true to apparent watts. The introduction of direct reading powerfactor meters has made calculation unnecessary and enables the determination of the powerfactor without trouble. Their use indicates whether induction motors on a system or on any circuit of a system are being properly operated, and enables the adjustment of

Fig. 2—9-inch Power Factor Meters.

the exciting current of synchronous apparatus to values giving the most economical powerfactor, also indicating a reversal of power if it occurs.

Of polyphase systems supplying a mixed load, powerfactor indicators are a necessity, as the calculation of powerfactor from other meters is complicated and difficult and may give very misleading results. A polyphase powerfactor meter having current connection in each phase of the circuit will indicate the average powerfactor of all the phases.

The illustrations show two types of direct reading powerfactor meters manufactured by the Westinghouse Electric & Manufacturing Company. These meters indicate on a graduated scale the powerfactor in the circuit to which they are connected.

The powerfactor meter operates on the rotating field principle. A rotating field is produced by the current of the metered circuit passing through angularly placed coils. In this rotating field is situated a pivoted iron vane or armature, magnetized by a coil whose current is in phase with the

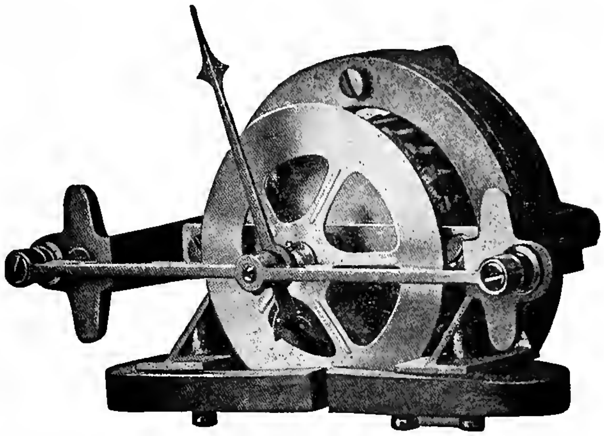


Fig. 3—Movement of Power Factor Meters.

voltage of one phase of the circuit. As the iron vane is attracted or repelled by the rotating field of the current coils, it will take up a position where the zero of the rotating field occurs at the same instant as the zero of its own field. Thus its position will always indicate the phase angle between the voltage and current of the circuit. The pointer attached to the armature, therefore, indicates this angle,

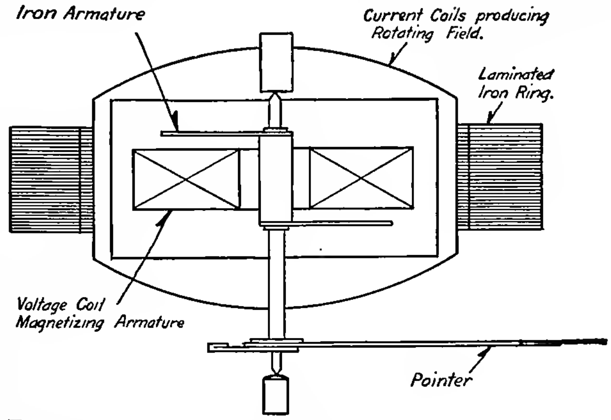


Fig. 4—Cross Section of Polyphase Power Factor Meter.

and, by marking on the scale the cosine of the angle shown by the graduation, the powerfactor is read directly. In the three-phase meter the rotating field is produced by three current coils spaced 60 degrees apart; in the two-phase meter, by two current coils spaced 90 degrees; in the single-phase meter, the position of voltage and current coils is interchanged and the rotating field is produced by means of a split phase winding.

Fig. 3 illustrates the movement of a type SI seven-inch powerfactor meter. The winding shown within the iron ring is the stationary winding of the current coils. Inside this, and not shown, are the stationary voltage winding and the pivoted armature. The laminated iron ring surrounding the winding is provided as a return circuit for the flux of the pivoted armature, so that the reluctance of the armature magnetic circuit is low and uniform in all positions. These parts are shown in the diagramatic cross-section, Fig. 4.

The aluminum disk shown in Fig. 3 at the front of the meter is a damping disk moving in the concentrated field of the two permanent magnets at the bottom of the mechanism. These magnets and disk have no effect whatever on the electrical operation of the meter. They serve to absolutely prevent oscillations of the pointer, and thus make the readings "dead-beat." The pointer, therefore, does not swing back and forth but comes to rest at once at its correct position. More efficient damping is obtained with this electromagnetic device than is possible with air damping devices unless a delicate and easily deranged adjustment is resorted to.

OZONE AND HOW IT IMPROVES VENTILATION.

In addition to an adequate amount of fresh air, the proper ventilation of shops, factories and other types of industrial plants require in many cases the use of a suitable deodorizing agent. Particularly is this so of such places as glue factories, abattoirs, and fertilizer factories, where foul smells abound, or where pungent and offensive fumes are in evidence. Great expense is also involved in maintaining proper temperature conditions and keeping the air pure, in order not to seriously impair the health of the employes.

Many observers have noticed a peculiar penetrating odor in the atmosphere during the passage of a thunder storm, and various causes have been attributed to it. Physicists have discovered that this same odor is produced when electrical discharges are passed through the air or oxygen. Schoenbein identified this odor as being that of a gas, which he named ozone, from the Greek word signifying smell. In his experiments, he proved that it was one of the most rapid and powerful oxidizing agents known to science. The method of production and general characteristics of ozone being known, it was natural for the scientist to produce it artificially as an aid to ventilation. The remarkable electrical developments have been of much assistance to him, and the ozonator, or electric ozone generator is the result.

Ozone is a colorless gas with a sharp penetrating odor, resembling that of chlorine in high dilutions, but when more concentrated, it resembles that of moist phosphorous. The chemical symbol is 0_3 and the gas is an unstable one under most conditions. It consists of 3 oxygen atoms, and is a form of oxygen in its most active state—concentrated oxygen. It is one of the most active oxidizing and deodorizing agents known to science.

Ozone is produced naturally by the lightning discharge and the same principle is used for its production artificially. An artificial lightning discharge of great area is provided by means of electrified plates, surrounding a field under electric stress through which air is passed. It has become generally known. therefore, that ozone can be quickly and conveniently produced by the passage of air between electrified surfaces. Apparatus built on this principle is in common use.

The manner in which ozone is produced in the General Electric Ozonator is interesting. A transformer raises the supply voltage to a point sufficiently high to operate the ozonizer, that part of the device is which the ozone is actually produced. This consists of a number of glass tubes coated with copper and containing aluminum vanes, separated from the inner walls of the glass tubes by small ring shaped air gaps. One of the high tension leads of the transformer is connected to the copper coatings of the glass tubes and the other is connected to the aluminum tubes. When the current is turned on, a violent electrical discharge occurs between the glass and aluminum vanes, and the energy of the electric field is absorbed by the oxygen of the air, producing ozone.

The action of ozone in destroying organic substances is so certain and rapid that ozone cannot exist except momentarily in air containing organic matter, hence the presence of ozone in the air is an indication that the air is not only sterile, but that gases and products of putrification have been reduced to harmless matter. It is therefore a powerful disinfectant in consequence of its oxidizing activity.

The General Electric Universal Ozonator for the purification of air consists of four essential parts, the ozonizer, a motor-driven blower, a step-up transformer and dust screen. The motor-driven blower with dust screen, together with fuses and controlling switches are mounted on the top of the wooden case and the ozonizer and transformer within the case, which is finished in flemish oak or imitation mahogany. The amount of ozone is most readily controlled by means of a simple 3-point switch, thus the amount of ozone produced can be easily regulated to suit different conditions.

Operating at full capacity the Ozonator gives a flow of 4000 cu. ft. of ozonated air per hour. This is sufficient to sterilize and deodorize the air in an enclosed space of 50,000 cu. ft., equivalent to that of the ordinary sized moving picture theater, bank or large school room. For larger spaces and storage rooms, or where decaying organic substances give off offensive odors and permit the growth of dangerous germs, the number of ozonators can be increased until the desired results are obtained.

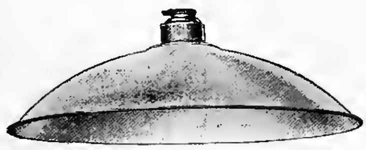
The General Electric Household Ozonator is ideal in every respect for household use. It has been designed to meet the various conditions found in residences and by means of the 2-point switch, should take care of any possible condition which might arise.

The General Electric Ozonator provides an economical and effective aid in solving the general problem of ventilation. It purifies the air without setting up draughts, it can be as easily and conveniently installed as an electric fan, and occupies a small amount of space. The operating cost is nominal, and it is invaluable where good ventilation is essential to health and comfort. These Ozonators are distributed on the Pacific Coast by the Pacific States Electric Company.

NEW NELITE INDUSTRIAL REFLECTORS.

The Nelite "Dome" is the latest metal reflector of the Nelite Works of the General Electric Company. As the illustration shows, it is a very shallow type of porcelain enameled steel reflector, designed for service where the so-called flat types have heretofore been employed. Its scientific design, however, gives the dome type several advantages, chief of which are the minimum glare effect and the desirable distribution of light, both of which are secured at no sacrifice of efficiency.

The dome type Holophane-D'Olier reflectors are particularly adapted to service in rooms with low ceilings or where the total area to be lighted is large in comparison with the distance between units.



Nelite Dome Reflector

The Nelite Works has greatly improved its steel department manufacturing facilities and methods, since taking over the Holophane business. Heavier steel is now used in the construction of all the smaller sizes of metal reflectors; a method of galvanizing has been perfected whereby the bodies of aluminized reflectors are rendered impervious to moisture and fumes, and an oxi-acetyline process of welding the holders to the reflector bodies is now employed, which makes the finished units as solid as a single piece of metal.

These developments have been carried on under the direction of Mr. Henry D'Olier, Jr., who promises further improvements in the Nelite lines of metal reflectors within the next few months.

NEWS NOTES

INCORPORATIONS.

BURBANK, CAL.—Burbank Electric Light and Power Company, $20,000, subscribed $300, by G. H. Deacon, W. Coryell, F. A. Faust, Laura Coryell and Helen M. Deacon.

ONTARIO, CAL.—The Pacific Electric Heating Company of this city has filed new articles of incorporation, changing the name to the Hotpoint Electric Heating Company. Directors are E. H. Richardson, N. R. Richardson and Franklin Booth. Capitalization is $312,500.

REDLANDS, CAL.—With a capital stock of $1,500,000 the Citrus Belt Gas Company has been formed with F. P. Morrison of Redlands, E. S. Moulton of Riverside, M. Ham, E. D. Roberts and Z. T. Bell of San Bernardino, directors. On August 1 the San Bernardino Valley Gas Company sold the property to the Citrus Belt Gas Company for $470,000.

ILLUMINATION.

OAKVILLE, WASH.—A. Welland has asked the city for a light franchise and will install a plant.

BURBANK, CAL.—G. H. Deacon was the successful bidder or an electric light and power franchise in this city.

ALHAMBRA, CAL.—Construction will begin at once on nearly four miles of projected lighted way between this city and Los Angeles.

BEAUMONT, TEX.—A lighting franchise has been granted to Stone & Webster for a 25-year extension of their electric lighting system.

HERMISTON, ORE.—J. A. Ralph, who recently disposed of his electric light and power company, in Dayton, Wash., has purchased the interest of Lee Shupe in the Hermiston Light & Power Company. The system will be thoroughly overhauled and extended and new lines built.

MANSFIELD, WASH.—Bids will be received up to August 15, 1912, for the purchase of general town bonds in the sum of $10,000, denominations not less than $100 nor more than $1000, due in twenty years, issued to acquire the plant of the Mansfield Water & Light Company.

LOS ANGELES, CAL.—Application has been made to the State Railroad Commission by the Imperial Valley Gas Company for permission to sell $200,000 worth of company bonds. The money is to be used in extending the corporation's service to include Brawley, Meloland, Holtville, Heber, Calexico, Seeley, Dixieland and Mexicali.

RIVERSIDE, CAL.—The Board of Public Utilities has followed up its recent action ordering all electric fans placed on meters, by instructing the superintendent of the municipal plant to have all lights now charged for under flat rates likewise placed on meters.

PORTERVILLE, CAL.—Actual transfer of the plant of the Home Gas Company of this city has been made to the new corporation, the Central California Gas Company. The new concern spent $30,000 here in paying off the old obligations of the company. A force of men is already at work putting in new mains which will carry gas to every residence and business house in this district, both in and out of the city limits. Within a short time work will be started on the high pressure system with which the gas is to be distributed to Exeter, Lindsay and Strathmore, and bettering the system.

SANTA CRUZ, CAL.—A complete reorganization of the officials, both local and district, of the Coast Counties Gas & Electric Company, which has been undergoing an adjustment during the past few years, went into effect on August 1st. As a result of the new plans for dividing the authority and segregating the work of the corporation, S. W. Coleman, who for the past few years has been the local manager, first of the old Santa Cruz Gas & Electric Company, later general manager of the Coast Counties Gas & Electric Company, doing business in three counties, will make his headquarters in San Francisco and will change his residence to Redwood City, probably about the middle of August or the first of September.

TRANSMISSION.

BOISE, IDAHO.—The Beaver River Power Company will build a brick building for a steam turbine station, also a brick substation.

KELSO, WASH.—The Washington-Oregon Corporation will extend its power line from this place to Chehalis and Centralia, a distance of 40 miles.

MOUNT VERNON, WASH.—The Stone & Webster Engineering Corporation has completed plans for six substations to be erected near this city for the Pacific Northwest Traction Company.

LOS ANGELES, CAL.—Eight bids on 7,000,000 lbs. of machinery and equipment for the municipal plant in San Francisquito canyon, now in process of erection, were received, the lowest bid being $300,000.

NAMPA, IDAHO.—The Beaver River Power Company, with a plant at Bliss, Idaho, will probably build its line through Nampa to Caldwall. If enough contracts are not secured here to warrant the service the line will be built from Boise to Caldwell direct.

OXNARD, CAL.—After once turning down an offer of $35,000 for its present lighting plant, when offered it by the City Trustees, the Ventura County Power Company has sent a message to the officials that it will accept that amount. The matter is to be taken up by the board within a few days and it is believed the voters will be asked to provide bonds to that amount for the purchase.

SANTA MARIA, CAL.—The Railroad Commission has rendered a decision granting the application of the Santa Maria Gas & Power Company for permission to issue bonds in the sum of $50,000 and to extend its service to the city of Arroyo Grande. The proceeds of the bonds will be used in the purchase of pipes and mains for the extension from Santa Maria to Arroyo Grande, for additional machinery and to refund floating obligations of $10,000.

NAPA, CAL.—The Great Western Power Company has filed suit in the Superior Court here against the city of Vallejo to condemn a tract of land in Wild Horse Valley, in this county for a right of way for the company's power line. The city of Vallejo owns the land. The company declares that it is necessary to cross this land in order to reach Santa Rosa with the line from Butte County. It asks the Court to determine the value of the land and condemn a sufficient tract for right of way purposes.

FRESNO, CAL.—A. G. Wishon has returned from a trip into Santa Barbara County for the purpose of securing franchises for the power line of the San Joaquin Light & Power Company, which is to extend to the coast. The power line will not only extend from Coalinga to the coast, but will have numerous branches on the coast, so that a network

of power lines will be spread through all the little valleys, into every town in the central part of the state, coast and even as far south as the Santa Maria oil fields.

SALEM, ORE.—The State Engineer, John F. Lewis, has put the official "O. K." on a project to develop 15,000 horsepower at the mouth of the Clackamas River. The scheme is being promoted by D. P. Donovan, late of Payette, Idaho, and it will call for an investment of $1,250,000. The money will be secured by stock subscription. The power, it is announced, will be used for general purposes, the state will collect under the grant 12½ cents per horsepower annually. The power is to be secured by flume canal five and one-half miles in length, which will give a sheer drop of 109 ft.

TRANSPORTATION.

ORANGE, CAL.—Maps of the Pacific Electric extension survey in and out of this city have been turned over to the local committee appointed to procure a right of way for the new electric road.

KLAMATH FALLS, ORE.—George C. Clark is one of the parties interested in building an electric road from Klamath Falls to Bonanza from 26 to 28 miles and to cost $10,000 to $12,000 per mile.

SEATTLE, WASH.—A resolution has been adopted by the City Council in which it is stated that franchises for street railway systems will be let to the highest bidder. Fifteen specified routes are included in the resolution.

PETALUMA, CAL.—Ground has been broken for the extension of the Petaluma-Santa Rosa electric road to the coast. The work was commenced near the Arthur Robinson ranch at Liberty and the road will be built westward to Two Rock. The work will be completed this year.

RIVERSIDE, CAL.—A vigorous denial has been entered here by M. A. Henshaw, President of the Crescent City Railroad Company, which proposes to build an extension connecting the Riverside-Bloomington electric line with Rialto, that it is in any way affiliated with the Pacific Electric Company.

TWIN FALLS, IDAHO.—I. B. Perrine has filed a trust deed for $3,000,000 running to the Central Trust Company, of Illinois, by the Twin Falls Railway Company, which means that the electric road from this place to Shoshone Falls will be constructed at once. Mr. Perrine states that the plans include a bridge 1180 ft. long and 540 ft. high a short distance below Shoshone Falls and the electric line extended to Jerome.

SAN FRANCISCO, CAL.—To further hasten the completion of the Geary street railway, the Board of Public Works has written to the Supervisors suggesting that bids be advertised for the building of the underground conduits planned to carry the feeders and cables for the railroad from Kearny street to Presidio avenue. These, it is estimated, will cost $533,850. The conduits will do away with much of the unsightly part of the overhead system.

PALO ALTO, CAL.—Fourteen engineers of the Fresno & Coalinga Tidewater Railroad surveying corps are stationed just north of Palo Alto and are working toward San Francisco laying out the line of a proposed railroad from the south. The survey follows the east line of the Southern Pacific to Santa Clara where it switches off to the bay line towards Mountain View and Palo Alto. It is stated that E. C. Shaw of Hollister has procured the right of way along the survey.

SAN DIEGO, CAL.—The San Diego, Riverside & Los Angeles Railway Company has arranged for the sale in Europe of $3,000,000 bonds, according to information given by that company in its application to the State Utilities Commission for authority to incur a bonded indebtedness of $8,000,000. All of these bonds are to be sold at 75 per cent of their face value. It has been announced here that Pursell will present to the San Diego City Council another bond to insure the construction of that part of his line within the city limits by November 1.

HANFORD, CAL.—Negotiations known to have been under way for some months looking toward the taking over of the Hanford and Summit Lake Railway Company by the Southern Pacific Company, have at length come to a focal point and, according to an announcement made to the employes of his division by Superintendent Worthington of Bakersfield, the H. & S. L. Railway's management has been undertaken by the Southern Pacific and will henceforth be a part of that company's San Joaquin Valley division. The recent sale of the James tract to the Graham interests of San Francisco for $3,000,000 and the taking over of the new road by the Southern Pacific Company bespeaks great things in the future of the fertile region in the southern portion of Fresno County. The announcement is made that the Graham interest will immediately subdivide its big tract containing thousands of acres and pursue a colonization scheme to attract Eastern settlers.

TELEPHONE AND TELEGRAPH.

ELMA, WASH.—Mrs. H. B. Waldron was granted a franchise to erect a telephone line in certain portions of the county.

SAN FRANCISCO, CAL.—The Pacific Telephone & Telegraph Company on August 1 announced an increase in the wages paid to operators in San Francisco, Oakland and some of its other exchanges, amounting to over $125,000 per year.

LOS ANGELES, CAL.—Application has been made by the General Research Company for permission to erect two steel flag poles upon tops of some tall buildings down town, for the purpose of establishing a long distance wireless telephone; height of poles to be 100 ft.

SAN FRANCISCO, CAL.—At a recent meeting of the Supervisors Gallagher asked that the exact status of the city's legal action against the Home and Pacific Telephone Companies be reported to the board. Assistant City Attorney Geo. Lull, although not engaged on the telephone case, was present and stated that evidence and testimony were being gathered and prepared for the suits to break the alleged merger.

PHOENIX, ARIZ.—In pursuance of the agreement entered into between the Overland Telephone & Telegraph Company and the Mountain States Telephone & Telegraph Company, providing for the sale to the last named company of all the property and assets of the Overland Company for the sum of $432,000, W. C. Foster, as treasurer of the Phoenix Savings Bank & Trust Company, the trustee under the terms of the contract, has completed the final steps in the consummation of the contract, and all the telephone properties of the Overland Company have passed into the hands of the Mountain States Telephone & Telegraph Company.

WATERWORKS.

SAN DIEGO, CAL.—The Empire Water Company has applied for permission to construct a hydroelectric plant near Coyote Creek, San Diego County.

REDMOND, ORE.—The Election carried in favor of issuing bonds in the sum of $35,000 for a waterworks system and $10,000 for general municipal purposes.

HAILEY, IDAHO.—An ordinance has been adopted providing for a bond issue of $40,000 with the proceeds of which a municipal waterworks system is to be installed.

SAN DIEGO, CAL.—The State Railroad Commission has ordered a hearing on the application of the Southern California Mountain Water Company to sell out to the city of San Diego, naming the date as August 19. Under the terms of the agreement the city of San Diego is to purchase outright a portion of the plant for $2,500,000, and lease a portion of the plant for a period of ten years, on an option to purchase this portion at $1,500,000. A bond election will be held in San Diego August 15, when the proposition of purchasing and issuing bonds in the sum of $2,500,000 will be voted upon.

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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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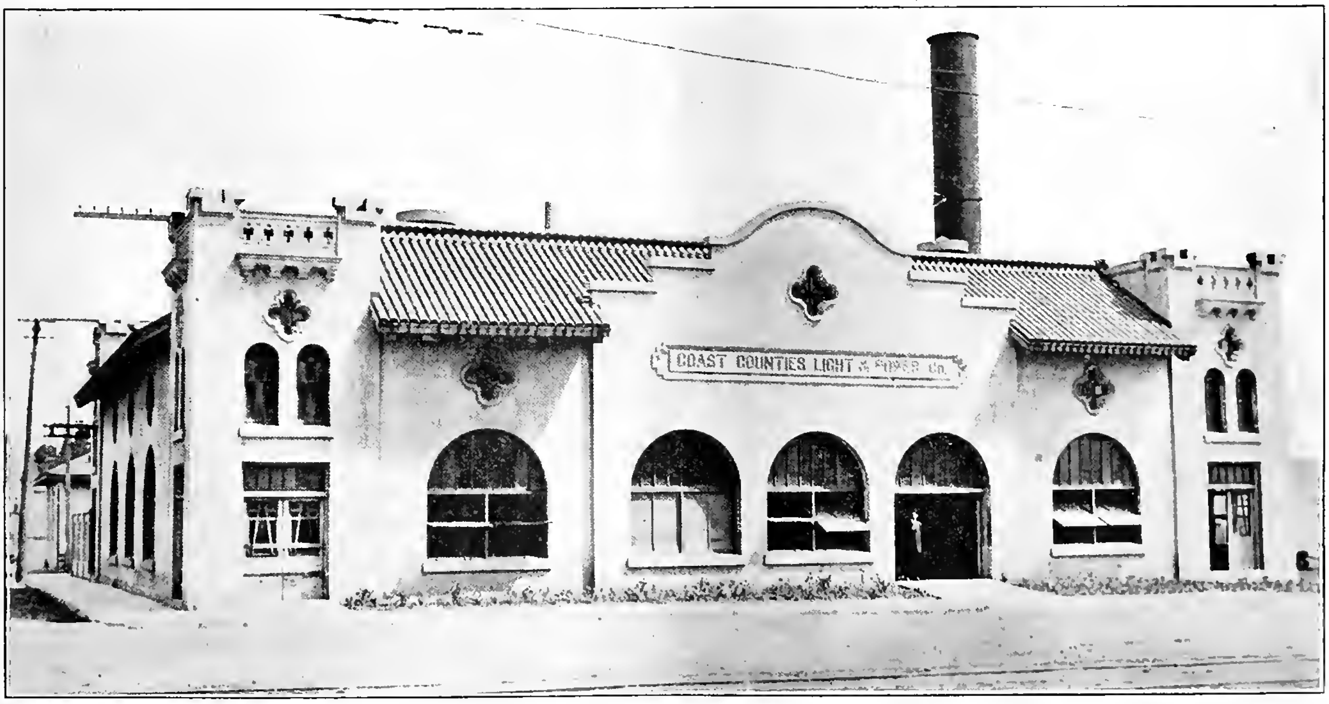
JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXIX SAN FRANCISCO, AUGUST 17, 1912 NUMBER 7

COAST COUNTIES GAS AND ELECTRIC COMPANY

The Coast Counties Gas & Electric Company was organized during March of the present year. Numerous small corporations during past years have been supplying electric light, power and gas to Santa Cruz, Watsonville, Gilroy, Ben Lomond and a number of the other cities of Santa Cruz, Santa Clara, San Benito and Monterey counties. As is manifested in the modern trend of affairs, concentration of hydroelectric distribution seems to work out the highest economic law for all concerned. The past several months, hence, has seen the consolidation of the Coast Counties Light & Power Company, the Big Creek Light & Power Company, the San Benito Light & Power Company, together with the Union Traction Company of Santa Cruz, combined under one corporate management represented by the Coast Counties Gas & Electric Company.



Steam Auxiliary Plant at Santa Cruz.

The territory served is situated within the fertile valleys of the counties above enumerated. It extends from the towns of Morgan Hill and Ben Lomond on the north to Hollister on the south and westerly to the coast.

Indicative of the increase in consumers of the past three years is the following tabulation:

Year.	Gas.	Electric.	Total.
1909	1912	3095	5007
1910	2017	3539	5556
1911	2725	4627	7752

The company has in operation one hydroelectric generating plant known as Station A which has a capacity of 1080 h.p.; a steam plant known as Station B with a capacity of 1266 h.p. and a steam plant at Watsonville known as Station C, with a capacity of 1000 h.p. Power is also purchased from the Pacific Gas & Electric Company at their Davenport station;

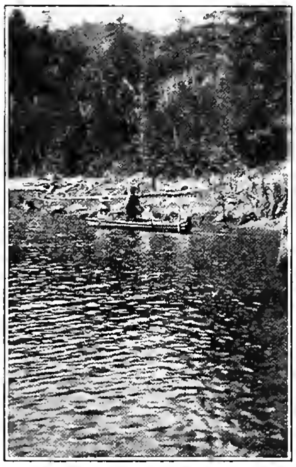
thus, continuity of service seems positively assured under all circumstances.

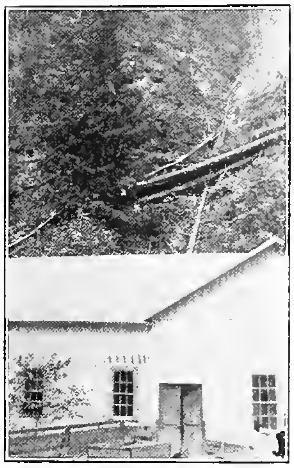
Three gas plants, situated at Santa Cruz, Watsonville and Hollister supply these growing communities with gas for cooking and heating. The street railway system of Santa Cruz is also controlled by this company.

The hydroelectric plant, referred to above, possesses interesting features, largely from a historical standpoint, for it is one of the oldest in the State of California, and for that matter, in the world, and yet today it is in efficient and continuous service.

Station A.

Station A, situated in the picturesque Santa Cruz Mountains, bespeaks the rapid advance of the hydroelectric industry. The tall ferns and picturesque tree growth surrounding this plant on all sides is emblematic of the picturesque art now scarcely twenty years old.





Storage Lake and Power House, Big Creek.

The power house stands on Big Creek about sixteen miles west of Santa Cruz in Santa Cruz County, California. From Santa Cruz it is reached by driving along the Ocean Drive, although, should the Ocean Shore Railroad be completed, it will be within three miles of modern transportation facilities. This power house, which is shown in the illustration, is of wooden structure, characteristic of the early design in hydroelectric practice. Within are installed two Pelton water wheels with two nozzles each, one driving a 450 kw. generator and the other two 180 kw. generators. There are two small water wheels, the one used in driving an 11 kw. Westinghouse exciter unit and the other to drive two 2½ kw. exciter units. Both are directly connected to their respective water wheels. The generators are of Westinghouse 2-phase, 7200 alternation, 1100 volt type.

Water is brought to the wheels through a single penstock line, varying from 16 to 14 inches in diameter. The total length is 1930 ft. with a vertical drop of 925 ft. The pipe is made up of long shop-riveted sections which were joined in the field. On the upper part of the pipe are slip joints caulked under steel collars. This steel pressure pipe is laid for the lower half of its course down the bottom of a step gulch and is designed to convey 40 cu. ft. of water per second at a velocity of 24 ft. per second.

The pipe line takes the water from a wooden forebay, which is at an elevation of 1116.9 feet above sea level and discharges it at an elevation of 191.9 ft. This wooden forebay, in turn gets its supply of water from a wooden flume line, which heads in Big Creek at an elevation of 1146.5 ft. The flume is 11,200 ft. in length and hence has a grade of 29.6 ft. in 2.12 miles. At a point 3400 ft. below its head the flume has an intake for waters from a branch of Big Creek known as West Fork and the same wooden forebay into which this flume discharges and from which the pipe line takes its water, also receives water from Mill Creek which is the drainage area next west of Big Creek.

The water from Mill Creek is delivered through a small wooden flume installed upon a much steeper

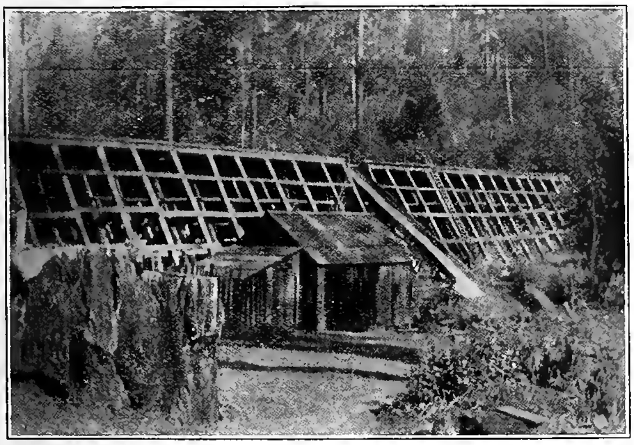
Type of Flume at Big Creek Illustrative of Early Design.

grade than the flume in Big Creek. The Big Creek flume is 18-28 in. and of double 1-in. redwood on a grade of 2.64 ft. per 1000.

The methods used in constructing a reservoir in the early days of hydroelectric practice are of much interest as showing the lines from which more recent practice have evolutionized. There are at present three storage reservoirs on the system. The Mill Creek reservoir is held by a wooden crib dam 50 ft. high which was partly filled by hydraulic means and partly by scraper. The dam is at an elevation of about 1400 ft. above sea or 250 ft. above the intake of Big Creek flume. It is a composite structure of great bulk. The down stream portion is a crib of large redwood logs filled with earth and rock and sheathed on its upstream face with seven inches of plank. Resting against this planking is a heavy hydraulic fill made up of decomposed granite. In washing this in place, the decomposed granite was so solid it had to be blasted. From an inspection of the dam

at this date it is believed that when the crib portion of the dam entirely rots away, the hydraulic fill on the up-stream side will have become reasonably tight and hence perform its functions without the aid of the crib. The dam is 500 ft. long and floods 18 acres and is tapped at a depth of 46 ft. The storage is about 350 acre feet and represents 254,000 kw. hours measured on the switchboard under a 1000 ft. head and 71 per cent efficiency. The outlet of the reservoir is from two 14-in. steel pipes with gates at the lower end. The drainage area serving this reservoir is one square mile. It is assumed that the average run-off is 1330 acre ft. with a minimum of 700 acre ft. In other words, that during years of deficient rain fall, the drainage area would yield twice the fill of the reservoir.

The waters from this dam are backed up ½ mile lower down by a small concrete dam which delivers them through a small flume 2½ miles long to the forebay or reservoir. About three-quarters of the length of this flume is an earth bridge built with an excavation of about 1/3 cu. yd. per linear foot. Near the head



Type of Dam, Big Creek Reservoirs.

is a trestle 350 ft. long and 75 ft. high. The workmanship on this trestle constitutes an illustration of efficient construction and to this day is in good operating condition. The flume is made of three boards, each 16 x 1¼ in. redwood. Yokes are 4 ft. center to center, sills are 2x 6, posts and caps 2 x 4.

The second storage is a forebay reservoir excavated in earth and rock on the ridge or divide between Big Creek and Mill Creek. This reservoir is about 300 ft. long and contains about 30,000 cu. ft. of water, which in the present power house will generate about 400 kw. hours. The wooden waste way from this forebay reservoir discharges back into Mill Creek. Water is received from the Mill Creek flume and from the Big Creek flume and then fed through a wooden penstock box into the pressure pipe.

The third storage known as the West branch reservoir on the west branch of Big Creek is situated at such an elevation that the outlet pipes discharge at an altitude of 1190 ft. above sea level. The type of construction is known as the rafter plan, that is to say, that it is made up of an inclined face sloping down stream held in place by inclined struts sloping up stream. It rests on a crib of horizontal timbers. The dam is 35 ft. high by 450 ft. long on top. The lower crib is filled with earth and rock. The wooden sheathing is backed on the water side by a light earth fill to render it more water tight. The outlets to this dam are through 14 in. and 16 in. pipes of sheet steel 3/32 in. thick with gates at their upper end under the water of the reservoir. The gates are controlled from a little platform reached by a plank footway leading over the dam. The waste-way is a wooden trough in the center of the dam. From the outlet of the dam the water is discharged into the West Fork whence it falls down over a waterfall and discharges into the flume which is at an altitude of 1135 ft. Hence there is a drop of 55 ft. from the pipe outlet of the dam to the top of the flume.

The waters of this dam flood some 12 acres, bringing about a storage of about 38 acre feet which represents 100,000 kw. hours power supply at the present power house. The drainage area tributary to this dam is 12 square miles, from which the run-off in average years would be about 2500 ft. or about 18 times the fill of the reservoir.

In the power house are found transformers arranged for Scott connection in order to deliver energy to the extensive three-phase system of the Coast Counties Gas & Electric Company. There are two 400 kw:. 1100 to 11,000-volt, one 250 kw., 1100 to 11,000-volt. and four 75 kw., 1100 to 11,000-volt transformers.

Although this constitutes the third oldest hydroelectric transmission plant in the State of California, having been put into operation in 1895, it is nevertheless today rendering good and efficient service to the extent of the water supply control in the various seasons of the year.

Station B, Santa Cruz Steam Plant.

The steam plant known as Station B, presents an outward appearance neat and attractive and in full keeping with California traditions. Its plastered exterior with tile roofing fully reminds one of the Spanish traditions among which the plant is located.

Installed in this plant may be found a 500 kw., 2200 volt, 2-phase, 60-cycle General Electric generator. This generator is directly connected to a Curtis vertical steam turbine of 500 kw. capacity. A 11 kw. General Electric exciter is belted to a 16 h.p. Sturtevant engine.

In addition to the turbine installation there is also a 200 kw., 600-volt, direct current General Electric generator belted to a 150 h.p., 1000-volt, 2-phase, type C Westinghouse induction motor. In case of a shutdown of the power supply, ample facilities are also provided by which this direct current generator may be belted to a Fitchburg steeple compound engine which is 16, 20 x 20. There is also still another General Electric 200 kw., 600-volt direct current generator belted to a second Fitchburg steeple compound engine 16. 20 x 20 in.

Three motor generator sets are also found among the equipment in this plant. A 400 kw., 600-volt d.c. General Electric generator is directly connected to a 500 h.p., 2200-volt, 2-phase, 60-cycle General Electric synchronous motor. A 5 kw. General Electric exciter is belted to the synchronous motor for magnetizing the field. A 100 kw., 575-volt direct current Westinghouse generator is directly connected to a 75 h.p., 220-volt, 2-phase, type C Westinghouse induction motor. while still another unit consisting of a 90 kw., 575-

volt d.c. Westinghouse generator is seen to be directly connected to a 75 h.p., 220-volt, 2-phase, type C induction motor.

Two 44 kw. line voltage regulators of the General Electric automatic I. R. S. type, together with switchboard and instruments make up the regulating equipment.

Steam is generated for the power supply in Babcock & Wilcox boilers. Two double drum boilers built for 160 lb. pressure with drums 20 ft. 4 in. long, 36 in. in diameter, with 4 in. tubes, 14 wide and 9 high having a rating of 300 h.p. are in one battery. A second battery of boilers consists of three single drum units built for 160 lb. pressure with drums 18 ft. 4¾ in. long with 4 in. tubes 9 wide and 7 high. These have a capacity of 150 h.p.

Three 50-light General Electric mercury arc rectifying outfits control the arc light circuits. The transformers are water cooled, arranged for Scott connection. There are two 440 kw., 22,000-2200 volt transformers and also two 150 kw. transformers with similar ratios of transformation. All are of the Westinghouse design. That portion of the current supplied to the mercury arc rectifiers is handled by three 50-light constant current transformers.

Among the auxiliary apparatus are to be found two boiler feed pumps of the Snow design, 6 x 4 x 6 in. The oil pumps for the turbine supply, 6 x 2 x 6 in., bear the Worthington stamp, while the two oil pumps, 4½ x 2¾ x 4 in., of the Snow design are used for the reciprocating units. A dry vacuum pump 6 x 14 x10 in. and an air compressor 7 x 10 x 6 x 8 in. are utilized to maintain proper vacuum conditions in the condenser. The condensers are of the Wheeler design, two in number, one having 800 ft. and the other 1800 ft. of condensing surface. A Goubert water heater with a capacity of 1000 h.p. completes the steam auxiliary equipment.

The building, though fireproof in construction, has in addition ample fire protection by means of its high pressure water supply. Faucets are located throughout the building and a 60-lb. pressure is maintained at all times to operate pumps in case of shortage from the regular supply.

Watsonville Steam Plant.

The Watsonville steam plant, although installed some years ago and in many respects not equipped with the most modern machinery is, nevertheless, operated whenever occasion demands auxiliary supply. The main equipment consists of a 750 kw., 2200-volt, 2-phase Westinghouse generator which is directly connected to a McIntosh & Seymour cross compound condensing engine with cylinders 21 x 42 x 4 in. A 20 kw. Westinghouse exciter is directly connected to the generator shaft.

The steam supply is derived from two double drum Babcock & Wilcox boilers which operate at 160 lb. pressure. The drums are 20 ft. 4 in. long with a diameter of 26 in. Tubes of 4 in. diameter are placed in the boiler, 14 wide and 9 high, thus giving a rated capacity of 30 h.p.

Two feed pumps of the Snow design supply the water, a Goubert heater from which the water is taken to the boiler, a set of Snow oil pumps, a Wheeler condenser with 2800 feet of condensing surface, an Edwards air pump, and an 8 in. d. c. centrifugal engine-driven circulating pump complete the auxiliary steam equipment.

The transformers are of the Westinghouse design and are equipped for the Scott connection. There are two which have a capacity of 250 kw. each and a ratio of transformation of 2200-22,000 volts. They are oil insulated and air-cooled. Two 22 kw. General Electric automatic I. R. S. line voltage regulators maintain proper voltage conditions.

The Union Traction Company.

The Union Traction Company, a subsidiary of the Coast Counties Gas & Electric Company, which operates the traction lines in and about Santa Cruz, presents interesting features. The special car arrangement with the Casa del Rey Hotel wherein a bus equipment is done away with is unique and suggestive of similar combinations in other coast resorts. The company furnishes a private electric car which conveys the guests arriving at the depot directly to the hotel.

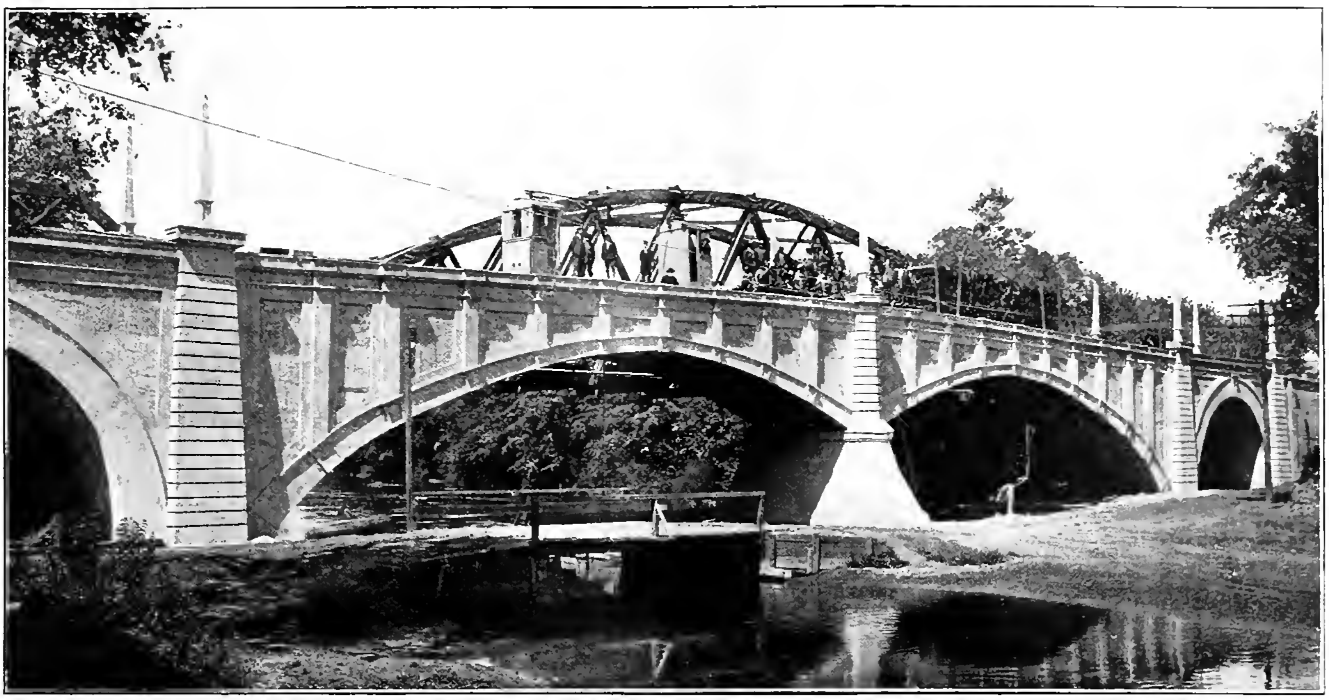
Type of Car, Union Traction Co.—Santa Cruz.

The car barns situate on Pacific Avenue and Sycamore street, maintained by the company, possess many features looking toward usefulness and ethical development of employes. The lockers and changing rooms provided are commodious and sanitary. Four separate tracks are maintained in the main room These have concrete pits in order to have easy access for cars undergoing repair. Fire protection is maintained throughout the car barn equipment.

The repair work for the gas plants in addition to the heavy work for the cars is done at these shops. One room, 18 x 18 ft., is maintained for armature winding where the company has an expert in this line of work. A foundry room for brass is kept in efficient condition. In addition, anchor rods, iron pins and wagon work are also put out when occasion arises.

In the rear, without the building, an efficient equipment is maintained to prepare the gas pipes for the "English coal tar" preparation. The pipes are capped with wooden plugs after being heated to a sufficient temperature, then dipped in tar and put on a vertical drain. Two men are all that are necessary in handling this equipment. The gas pipes are mostly of 2 in. in diameter for the high pressure system, the pressure maintained for distribution being from ten to fifteen pounds.

As shown in the photograph, the cars are of sub-



Concrete Bridge, Union Traction Co.—Santa Cruz.

stantial design. All cars of the company are painted blue which undoubtedly is done in order to be indicative of the summer atmosphere and the surroundings found here. Rails of 60 lb. weight are used in construction of the track. The cross ties employed in the road work are from the heart of the redwood. The ties are of the split design and though installed in 1907 are today in perfect condition.

The management has found that one man with an electric automobile can set as many meters as two men with a horse and wagon and as better service is thereby maintained, the meter department is operated with the former mode of conveyance. At Watsonville are maintained a car for the gas service and one for the electric, at Hollister one electric and one gas car are kept in service, while at Gilroy, where the company has leased the municipal plant, a gas car is maintained in service.

The management of the company pursues a liberal policy and the first sign that meets the glance of the consumer as he enters the company's office is the following: "Suggestions for improvements in either electric, gas or railway service cordially received. Please place in this box. General Manager." Immediately below this sign is a box where these suggestions may be deposited and this has enabled the management to give the high class service maintained in the past.

Electric Circuits.

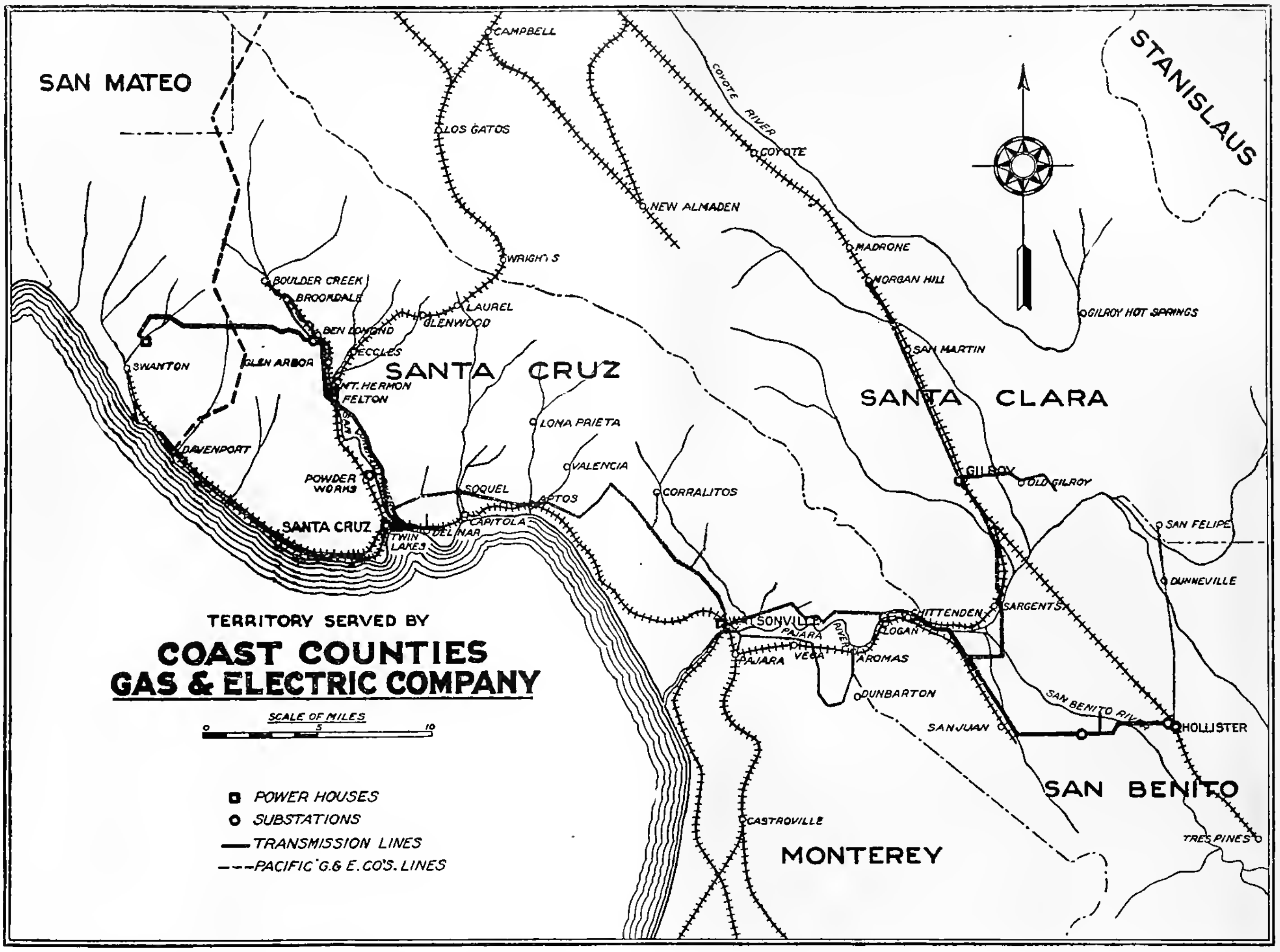
There are in the high tension net-work 41 miles of No. 4 copper and 21 miles of No. 6 copper 3-phase transmission which is maintained at 22,000 volts. In Santa Cruz, the distributing circuit, which is 2200 volt, approximates 8 miles in length and of 2-phase distribution, and another circuit 24 miles in length, of single-phase distribution. The Watsonville network comprises distribution at 2200 volts with a 25-mile 2-phase circuit and a 10-mile single-phase circuit. At Gilroy similar voltage distribution is maintained with 13 miles of 3-phase circuit and 5 miles of single-phase circuit. At Ben Lomond, Brookdale and Mt. Hermon approximately 4½ miles of single-phase distribution is to be found. An idea of the length of distribution required in low voltage networks of 110-220 volts is given from the fact that some 50 miles are installed at Santa Cruz and 30 miles at Watsonville.

Substations.

A number of substations are installed in the extensive distribution system of the company, the more important of which are as follows:

Hollister Substation.

At Powder Mill, four 3-pole 22,000-volt air-brake switches with two 22,000 meter outfits are installed. At Larcen may be found one 2-pole 22,000 volt air-break switch with a meter outfit sufficient for a 10 h.p. motor. The Spreckels substation contains one 2-pole, 22,000-volt, air-break switch, two 5 kw. 11,000-220-volt transformers and a 220-volt meter outfit.



At Lilliancrantz is installed one 2-pole, 22,000-volt, air-break switch, two 10 kw., 11,000-220-volt transformers and a 220-volt meter outfit. The Granite Rock substation contains a 3-pole, 22,000-volt, air-break switch, an oil switch of similar proportions. Three 75 kw. and two 50 kw. 22,000-440-volt transformers are also installed at this distribution point, together with two meter outfits.

At Gilroy a 3-pole, 22,000-volt, air-break switch with an oil-break switch of similar proportions, together with a General Electric automatic I. R. T. line voltage regulator are to be found. Two 75 kw. 22,000-2200-volt transformers with switchboard and instrument complete make up the equipment.

At the junction of the point of the former San Benito distribution lines, a 22,000-volt metering outfit is maintained, while Brookdale has a switchboard with adequate meters and Mt. Hermon a metering outfit for the connected load found there. Ben Lomond has in its substation a 75 kw. 22,000-2200-volt transformer. Control is maintained through a 3-pole 2200-volt air-break switch and 2-pole air-break switch of similar proportions, a switchboard and necessary instruments complete the equipment.

In Santa Cruz 1732 poles and 1593 kw. in distributing transformers is required to supply the 2542 consumers. In Watsonville 989 poles and 936 kw. in transformers is necessary to supply the 558 consumers.

Gas Works at Santa Cruz.

The rapid growth to 1608 gas consumers at Santa Cruz which is supplied through mains aggregating a total length of over 31 miles has brought about an efficient system of gas generation. The company has voluntarily reduced its rates and during recent weeks the following block system has been put into effect, which materially reduces the former rates in vogue:

	Gross per M.	Net per M.
First 2,000 cubic feet per month..............	1.50	1.40
2,000-20,000 cubic feet per month..............	1.35	1.25
20,000-30,000 cubic feet per month..............	1.25	1.15
Over 30,000 cubic feet per month..............	1.10	1.00

The 10c per 1000 cu. ft. discount is allowed on all bills paid at the office before the 10th of each month.

The gas works at Santa Cruz consists of a 10,000 and 5000 cu. ft. Lowe generators. Four purifiers 8 x 8 x 5 ft. relieve the gas of sulphur ingredients. Two gas holders—one 30,000 cu. ft. and the other 20,000 cu. ft. capacity are installed. A 10 x 10 in. electrically driven compressor and a 10 x 12 in. steam driven compressor segregate all harmful ingredients from the gas which have passed the purifiers and before the same is taken into the city distribution mains.

An engine driven exhauster of 18,000 cu. ft. capacity, together with an 8 in. exhauster of 18,000 cu. ft. capacity, and an 8 in. engine drive blower complete this phase of the equipment. Two boilers of twenty and eighty h.p. of Babcock & Wilcox design are maintained in readiness in case of discontinuity in electric supply for operation of the gas plant.

The Watsonville Gas Works.

The Watsonville gas works, though small and of long standing, is, nevertheless, most efficient in its operation. The equipment consists of a 5000 and a

2500 cu. ft. Lowe gas generator. Two purifiers 10 x 10 x 5 ft., two holders, one 30,000 cu. ft. capacity and the other 10,000 cu. ft. capacity, complete the main equipment. A 10 x 12 in. steam driven compressor and two boilers of Babcock & Wilcox design, the one 40 h.p. and the other 20 h.p. capacity, complete the steam generating equipment of the plant. There are 761 gas consumers in Watsonville and the distribution system comprises over 12½ miles.

The Coast Counties Gas & Electric Company control blanket franchises covering the use of all highways in Santa Cruz, Monterey, Santa Clara, and San Benito counties, also franchises in the cities of Santa Cruz, Watsonville, Gilroy, Morgan Hill, San Juan and Hollister.

Electrical Pumping Plant, San Juan Valley.

The franchises in Gilroy grant the use of certain highways for lines through the city to reach the surrounding country but provide that the company must not compete with the municipal plant. This plant is now, however, being operated under a five-year contract by the Coast Counties Gas & Electric Company.

Pajaro Valley is typical of the tributary district. The area of the valley comprises about 120 square miles or 76,800 acres. Rain rarely falls between May 1st and October 1st. The industry of first importance is that of growing apples. The climate and soil of the valley is particularly adapted to this purpose and the production and shipments are greater than any other single district in the world. More than 4000 carloads or 2,500,000 boxes comprised the shipment last year.

Next in relative importance is the berry crop. Strawberries, blackberries, loganberries, raspberries and other varieties thrive here and during the season as many as 5,000,000 lbs. have been marketed. Apricots, prunes, grapes, pears and cherries are produced in commercial quantities. Oats, barley, hay, alfalfa, sugar beets and potatoes are profitably grown. Stock raising and dairying constitute important industries, while poultry raising is recognized as of immense future profit to growers in this district

The Hollister Valley is of similar productive proportions. This valley spreads fan-like from about and above the town of Hollister and embraces about 20,000 level acres. Naturally moist with a sedimentary soil of great depth, rich in plant food and easily cultivated, this valley is just now coming into its own. San Juan, which was once part of a princely estate of about 1,000,000 acres given away by the Mexican government and known as the Spanish Grant, is another valley of promise. In this valley are more than 20 square miles composed of as fine land as any country can show. Like the Hollister Valley, the soil is a rich alluvium, very deep and underlaid with artesian water and suitable for all kinds of high priced crops.

Shot Gun Alarm at Hollister.

San Benito County has two sources of water supply, gravity ditches and artesian wells. The San Benito Water Company now furnishes 3000 acres but is extending and improving the system and will shortly cover 10,000 acres. Irrigation has increased land values in this section $2,000,000 and will continue to add immensely to the productive capacity of the land as the area is enlarged.

The artesian belt is making a rich district around San Felipe. The wells do not as a rule flow; hence the use of pumps is general. The lift averages 15 ft. and cost of electric pumping is about $1.00 an acre per year to put water on the ground in proper proportion. The possibilities for future consumption of electric power from this source is of enormous proportions.

Illustrative of the natural genius involved in a new country under new conditions is the photograph shown herewith, showing an irrigating canal and shot gun. An industrious farmer in his endeavor to cut down operating expenses, in other words to do without the employment of another man to watch his irrigating supply, has installed a shot gun, the trigger of which is attached to a float in the ditch below. If for any reason a discontinuity in the water supply occurs and the water goes below its accustomed level, the shot gun is automatically fired and the rancher is thus notified even though he be industriously engaged in a distant corner of his ranch.

HOW THE CHICAGO AND CLEVELAND STREET RAILWAY SETTLEMENTS ARE WORKING OUT.[1]

BY DELOS F. WILCOX.

There are many types of street railway franchises in operation in the United States, but the only two cities which have thus far worked out general street railway settlements of national importance and national interest are Chicago and Cleveland. Chicago has an area of about 190 square miles and a population of 2,185,000, according to the last census, or nearly seven times the population of Los Angeles. Cleveland is a much smaller city, having only a little more than 40 square miles of area and a population of 560,000 in 1910. The two cities may be compared from a street railway standpoint by stating that the total number of passengers carried on the surface street car lines in Chicago is almost 600,000,000 a year, while in Cleveland the number is a little more than 200,000,000. The larger number of riders in Cleveland in proportion to population is accounted for partly by the fact that the elevated roads in Chicago handle a large part of the local passenger traffic, and partly to the fact that in Cleveland traffic has been stimulated by the lower fares. The relative magnitude of the two cities from the street railway standpoint may also be seen from the fact that the recognized capital value of the Chicago systems on February 1, 1912, was about $127,500,000, as against about $24,500,000 for the Cleveland property as of February 29, 1912

Chicago.

The Chicago settlement ordinances have been in operation for a little more than five years and the Cleveland ordinance for a little more than two years. The practical administration of the Chicago ordinances had been under the direct supervision of Bion J. Arnold, who, aside from Mr. Walter L. Fisher, was the chief factor in the original negotiations. The administration of the Cleveland ordinance was for the first two years in the hands of a stranger. Both Tom L. Johnson and Judge Robert W. Taylor, the two men most responsible for the Cleveland settlement, died soon after the ordinance went into effect. Since January 1, 1912, however, the administration of the ordinance has been in the hands of Newton D. Baker, now mayor of Cleveland, and Peter Witt, City Street Railroad Commissioner, both of whom were trusted lieutenants of Tom Johnson.

The Chicago ordinances were the outgrowth of many years of financial exploitation, political corruption, intolerable service, stubbornly contested litigation and prolonged public agitation almost unparalleled in the history of the American cities. During the preliminary period the people of Chicago became converted to the principle of municipal ownership, but found themselves so entangled in constitutional and statutory restrictions, so lost in administrative chaos, and so handicapped by the fag ends of unexpired privileges, that the great, rich city of Chicago, could not, absolutely could not, buy up the antiquated junk which passed for a street railway system, and itself undertake to rehabilitate and build up a transportation utility worthy of a progressive city. The city had statutory authority to acquire and operate street railways, but as finally interpreted by the Supreme Court of Illinois, this authority was subject to financial conditions which the city could not possibly fulfill. In other words, one law gave the city powers which other laws prevented it from exercising. On the other side the franchises were expiring and in a notable decision, the United States Supreme Court definitely denied the companies' most important claims. Yet the companies were in possession of the streets, and the railways, wretched as they were, had to keep going. A great city of two million people clamored angrily and persistently to be carried in decent cars at a reasonable speed. The great issue was better service, and municipal ownership as a means to get it. The deadlock could not continue. Out of these impossible conditions strong men fashioned a compromise and drove it through. The city was unable legally and financially to get immediate municipal ownership, but it could not postpone any longer the immediate rehabilitation of the system and the service. The surface street railways of Chicago, barring certain comparatively unimportant outlying lines, were operated by two companies, which served separate districts, but had access in common to the business heart of the city. The settlement ordinances applied to both companies.

To smooth the way for municipal ownership, the existing properties were appraised and the value was written down in a book at the round figure of $50,000,000, twenty-nine millions for one system and twenty-one millions for another. It was agreed that the new capital required for the reconstruction, re-equipment and extension of the lines should also be written down in the book from time to time and added to the original valuation. The sum as shown was to be the purchase price, and the city would have the option at the end of any period of six months to walk up to the counter, lay down the price, and walk off with the goods. All the uncertainties of future appraisals, litigation, corporate resistance and complex disputes were wiped out. The purchase price was fixed. City money, whenever it was forthcoming, would talk. This particular option, however, would not be effective during the first period of twenty years, except for municipal operation, although if the city itself could not take over the property for municipal operation, it could organize a licensee company limited to a 5 per cent profit, and the latter could take over the street railways to operate them as trustee for the city's benefit, by paying the same purchase price. Moreover, the city could designate as its licensee and properly authorized new company, not limited as to profits, and in that case the licensee could take over the property by paying the purchase price plus a bonus of 20 per cent. After twenty years this bonus would not be required. In the meantime, the roads were to be rebuilt and re-equipped and not less than a specified minimum mileage of extensions was to be added each year. A board of supervising engineers, consisting of Mr. Arnold as chief engineer and chairman, a representative of the city, and a representative of the company in each case, was established, principally for the purpose of supervising the work of rehabilitation, certifying additions to capital, and determining what expenditures should be charged to the various accounts. On the companies' actual expenditure for capital account, they were to be allowed certain additional amounts—10

[1]Paper read before the National Municipal League, Los Angeles, Cal., July 12, 1912.

per cent for contractors' profit and 5 per cent for brokerage. Moreover, for the three-year period fixed as the period of "Immediate Rehabilitation" 70 per cent of gross receipts was arbitrarily set aside for operating expenses, and it was provided that anything spent for renewals during this three-year period in excess of what might be available for that purpose out of this 70 per cent should be added to capital. Street railway fares were fixed at 5 cents for adults and 3 cents for children between seven and twelve years of age. Children under seven properly attended, were to be carried free. Except in the downtown business district, comprising an area of about 2/3 of a square mile, free transfers were to be given that would enable a passenger to ride from any point on either system to any other point on either system, not involving a return trip. Through routes were to be operated over both systems as listed in the ordinances. The companies were to be allowed five per cent interest on the recognized capital value or purchase price as written down in the book. This allowance was to come after operating expenses, including maintenance, renewals, accident reserve and taxes. Specific percentages of revenues, subject to modification by the board of supervising engineers, were to be set aside to insure the upkeep of the property to the highest practicable standard of efficiency.

After the companies had withdrawn their 5 per cent return on capital, the net profits were to be divided in the ratio of 55 per cent to the city and 45 per cent to the companies. It was stipulated that the city's share of the profits should be placed in a fund for the purchase and construction of street railways. The expenses of the board of supervising engineers were to be charged to capital account during the three-year period of immediate rehabilitation, and thereafter to operating expenses. Mr. Arnold's salary as chairman of the board was fixed at $15,000 a year, and he was allowed $15,000 a year additional as chief engineer during the period of reconstruction. In case the companies failed to comply with the provisions of the ordinances for a period of three months exclusive of time during which, without their connivance they were delayed or interfered with by unavoidable accidents, labor strikes or court orders, their rights under the ordinances might be forfeited, but in any such case the rights of mortgagees to recover by foreclosure up to the full value of the property as reflected in the purchase price, were not to be affected. In other words, forfeiture was run against the operating companies, but not against their bond holders unless and to the extent that bonds had been issued in excess of the value of the property.

How has this scheme worked? Chicago has got a physically reconstructed, high-grade street railway system. Practically all the small outlying lines have been brought into the scheme and are now being operated by one or the other of the two companies. This means a universal five-cent fare for adults and free transfers throughout the city, except in the downtown business district. This limitation of the transfer privilege was designed to prevent abuses. It operates to the inconvenience of a number of people who have to walk from a block or two to perhaps a third of a mile to reach their downtown destination, or else pay a second fare. The through-route provisions of the ordinance have not yet been worked out satisfactorily, largely as a result of the jealousies and conflicts of interest of the two companies. Only 9 per cent of the cars entering the business district are through-routed, with the result that a passenger desiring to pass through the heart of the city must submit to considerable delay in waiting for a through car or in making a detour by transfer around the business district, or must change companies and pay a second fare. Downtown traffic is badly congested, partly by reason of the fact that 91 per cent of the cars switch back or go around short single track loops, crossing and recrossing each other's routes with resultant confusion and delay. Service is generally good so far as physical equipment is concerned, but there are serious complaints of overcrowding during the rush hours. No trailers are used.

The original purchase price, including the smaller properties since brought under the ordinances, was $55,775,000. On February 1, 1912, after five years, their aggregate purchase price was $127,492,398.37, an increase of 128 per cent. During the five years period the companies had received about $22,000,000 as interest on their investment, $6,432,183 as their 45 per cent of net profits and about $9,000,000 as their percentages of profits on rehabilitation, a total of approximately $37,500,000 or the equivalent of 8.5 per cent per annum on their investment as shown by the purchase price. During this same period taxes paid to the city and other public bodies amounted to about $4,800,000 and the city's share of profits amounted to $7,804,000.

The Chicago Settlement Ordinances are a great constructive work of municipal statesmanship. They are the practical outcome of the first big battle in this country to recover for a great city the control of its streets. In the light of Chicago's experience, many other battles will be fought before the cities of America have attained the complete ownership and control of their highways, which is, in my opinion, a prerequisite to the full realization of civic democracy, the assumption by the city of the self control necessary to transform the cities in which a few of us now grow rich and many of us now grow poor, into cities in which we may all live a full and free life.

Certain serious mistakes in Chicago's policy have been revealed as the result of five years' experience. The possibility of municipalization was intended as a check upon the companies. In fact these ordinances were represented as giving them one last chance to make good as servants of the people. The sword of municipal ownership being suspended at all times above their bowed necks by a slender thread. In five years' time that slender thread has grown mighty stout, until timid capital all over the country is clamoring for a chance to bed its neck under a sword suspended by that kind of a string. While the city has been accumulating a purchase fund of about $8,000,000, the purchase price of the property has increased nearly $80,000,000, and the companies have been making 8 per cent on that price. At this rate, Chicago will not be likely to continue long to regard as of great practical value, the simple announcement of its famous

contract: "Just walk up with the money and you can walk off with the street railways."

The mistakes of the Chicago Ordinances are mainly three:

1. They permanently capitalize many millions of dollars of franchise values, superseded properties, city pavements and construction profits, which never should be capitalized at all except as a last resort, and in that case should be amortized out of earnings as a first charge after the payment of their interest rates on the investment. It is impossible to tell from the figures available just how much of the purchase price of the Chicago street railways represents bona fide present value of tangible property. I believe, however, that at least 20 per cent or 25 per cent of the purchase price represents elements that never should be permanently capitalized. In fact, it is fairly certain that in the process of rehabilitation, more dead capital has been added to the account than the entire accumulation of the city's purchase fund.

2. The second mistake in the Chicago Ordinances is their failure to provide for the investment of the city's purchase fund, in the securities of the street railway system. While the companies are pouring new millions of capital into new car lines and getting 5 per cent brokerage and 5 per cent a year as a minimum return, the improvident city puts its money into the bank and gets 2¼ per cent interest on it.

3. The third serious mistake of the Chicago plan is the indefinite and inadequate provision for the permanent supervision of service by the board of supervising engineers after the expiration of the reconstruction period. The ordinances are not very clear on this point, but the board is unquestionably very limited in its initiatory jurisdiction over service matters.

Cleveland.

Turning to Cleveland, we find a franchise settlement of another type. There, as in Chicago, the ordinance finally adopted was the outgrowth of years of litigation and political struggle. But in Cleveland the service had not been so badly neglected and the corrupting activities of the street railway interest had not been so bold and brutal. The main struggle in Cleveland was for lower fares, with municipal ownership as soon as conservative Ohio would permit it. Tom Johnson, as a practical railway man and a radical civic statesman combined asserted the practicability of three-cent fares and pending the working out of the municipal ownership program, demanded politically that the street railway company of Cleveland should be deprived of its monopoly profits. Unable to attain his purpose by negotiation, he did not hesitate to establish a competing line under franchise practically granted by himself to himself as trustee for the public. My time does not permit of a review of Johnson's long fight. The settlement known as the Taylor ordinance was finally put through in the face of Mr. Johnson's personal opposition and went into effect March 1st, 1910. Under this settlement the value of the property was agreed upon, as in Chicago, and provision was made for additions to capital account from time to time, subject to the city's approval. As yet Cleveland does not enjoy even the theoretical right to own and operate street railways, but looking to the future, the ordinance reserves to the city the right, when it is legally competent, to take over the property at the recognized capital value plus a bonus of 10 per cent on the portion of that value not represented by bonds.

The city is also authorized to designate a licensee company which will be permitted to acquire the property at the same price on the condition that it will agree to accept a smaller return by at least ¼ of 1 per cent on the portion of the capital value represented by capital stock than the original company is at the time entitled to receive. But the original company must be allowed to submit a bid before a licensee is designated, and no licensee may be designated unless it underbids the original company. At the expiration of the franchise or any renewal of it, the bonus will not be required as a part of the purchase price.

Aside from the provisions for purchase, the main idea of this ordinance is that the company shall receive a fixed rate of return upon its investment, and all surplus profit shall be prevented by an automatic readjustment of fares in accordance with a detailed schedule in the ordinance itself, which provides for a range between a maximum rate of 4 cents cash fare, seven tickets for a quarter, and one cent for a transfer, without rebate, to a minimum rate of 2 cents cash fare, one cent for a transfer and one cent rebate when the transfer is used. Between these extremes are eight intermediate variations in the rates. When the ordinance went into effect, the rate was three cents cash fare, one cent for a transfer and no rebate. A certain fund was established to operate as the financial pulse of the street railway system. This fund was started off at $500,000, and it was provided that whenever the fund increased to beyond $700,000 the fares should automatically be lowered, and whenever the fund went below $300,000 the fares should be raised. In case of dispute between the city and the company about the necessity of a change of fare other than by this automatic arrangement, the matter was to be submitted to arbitration. But in case the city ever let the franchise come within fifteen years of expiration, the company should be entitled to charge a maximum rate provided for in the schedule, and apply all surplus profits to a reduction of capital, which would, in case of subsequent purchase by the city, go to reduce the purchase price. The company was allowed a fixed amount, 11½c per active car mile of motor cars and 60 per cent. as much per car mile of trailers, for operating expense, and also a fixed amount per car mile for maintenance, renewals and depreciation. This latter allowance varies with the seasons, but averages about 5c per car mile. These allowances may be changed by agreement or by arbitration. The company is allowed to withdraw each year from the interest fund a sum equal to six per cent. on its bonds. New stocks and bonds may be issued, but, unless approved by the city, they do not become a part of the capital value.

The city appoints a street railroad commissioner, whose offices and supplies are furnished, and whose expenses and salary are paid by the company as an operating expense. The amount of the commissioner's salary is limited to $12,000 a year. The present commissioner gets $7,500, the same as the heads of the other city departments. The expenditures for salaries for commissioner and his assistants are limited to one per cent. of the company's operating allowance in any one month, except that in checking construction ac-

count, the commissioner may spend not exceeding one per cent. of the estimated cost of the proposed additions, extensions and betterments. The commissioner is the technical adviser of the City Council. He has very little ultimate authority except in the way of the examination of the company's accounts and practices. Backed by the City Council, however, he has absolute control of car schedules and service. Nearly every other question of dispute between the city and the company may be referred to arbitration.

On March 1, 1910, the new plan started off with three cent cash fares and a penny-for-a-transfer, with no rebate. The company has spent more than the ordinance allowance both for operation and renewals. But the overdrafts in the funds, until authorized by the city or by arbitrators, do not affect the interest fund, which determines the fare. On June 1, 1911, the interest fund having passed the $700,000 mark, the fare was reduced one notch to three cents, with penny-for-a-transfer and penny rebate. That is practically three cents straight, as the thrifty Clevelanders do not buy transfers unless they are sure of using them, in which case they get their money back. A passenger may buy five tickets for fifteen cents, but unless he does buy tickets he must present the exact change, three pennies for one ride or six cents for two, or the company will keep his nickel. In practice a little more than one per cent. of the rides are at the nickel rate. From June 1, 1911, to the present time, the three cent fare has been maintained. This is in spite of a deficit in the operating and renewal fund. For a period of eight months in 1911 the city allowed the company an extra cent per car mile for operation. Otherwise the allowances have been as set forth in the ordinance. During the first year the company spent and took about $199,000 more than the gross receipts, and during the second year about $362,000, making the gross deficit for the two years about $561,000. That is practically equivalent to the penny-for-a-transfer charge for one year. It should also be noted that the city fare is maintained to the suburb of East Cleveland under an old franchise requirement at a heavy annual loss estimated by the city at not less than $300,000. In Cleveland, when tracks, cars, etc., are replaced their full original cost is charged to maintenance, while in Chicago only the original appraised value is so charged.

Cleveland is getting fair service at a three cent rate. It may be that the increase in traffic will overcome the deficit thus far accrued. The city Street Railroad Commissioner has ordered a hundred new fifty-five foot inside measurement trailer cars to cut down operating expenses and relieve the rush hour traffic. Gross receipts in April, 1912, were about $4,000 greater than 1911, in spite of the lower rate of fare which represented a loss of approximately $50,000 revenue. In Cleveland the city has a right to designate and order improvements to the amount of $2,500,000, which are to be made this year or next. Extensions, betterments and improvements, generally, may be ordered by the city, and the company must make them, if it can, acting in good faith, secure the funds, unless it claims that the proposed expenditures will impair the future ability of the property to earn the stipulated return on investment. In that case the matter goes to arbitration. The city cannot, however, propose any improvements after it has let the franchise come within fifteen years of expiration. Improvements proposed by the company may be made if so approved by the city.

Cleveland has made the same mistake as Chicago in permanently capitalizing franchise and pavement values; and making no provision for reduction of the capital, except during the fifteen year period to the expiration of the franchise. The people are being saved a lot of money. The company's motive for economy is destroyed, but thus far expenditures are being pretty well held in check by arbitrary provisions of the ordinance and the supervising alertness of the City Commission and the City Council. It is reasonably certain that in spite its low fare and no profits, Cleveland will not have any harder time than Chicago in buying out the local street railway system.

The experience of the two cities points to one conclusion, namely, that if the municipalization is to be either actual or potential, all franchise values and superseded and imaginary property must be wiped out of the permanent capital account. If this is done and the city wishes to municipalize, it can do so by requiring the property to pay for itself out of earnings. The increased safety of the investment will alone pretty nearly supply the amortization fund without any higher fares. This seems to be the only practicable plan of municipalization that does not involve the assumption by the city of enormous additional debts.

POWER DEVELOPMENT VALUES.

Much is found in the recent technical press notes relative to capitalization of water rights. The California Railroad Commission has recently encountered the problem in the fixing of rates in and about Redding in which the public utility supplying the light and power to northern counties desires to place a valuation on its water rights aggregating some eight millions of dollars.

The possibility of creating values by power development is shown by the plans adopted by the city of Los Angeles for bringing a municipal water supply from the Owens River to that city. The value of the water supply would have justified the cost of constructing the aqueduct which will bring pure mountain water a distance of 250 miles in sufficient quantity to supply a city of 2,000,000 inhabitants.

The system will deliver 258,000,000 gallons (net) every twenty-four hours into reservoirs located nearly 1000 feet above the city. It consists of 98 mlies of covered conduits, 40 miles uncovered, 21 miles of open canal, 12 miles of inverted syphons, 43 miles of tunnels 10 to 13 feet in diameter, and 4 reservoirs along the line holding three months' supply.

The total cost will approximate $25,000,000, and the water power incidentally created will be utilized in producing 120,000 horsepower peak load of electrical energy, the sale of which will provide a fund large enough to cover the interest and create a sinking fund that will eventually pay all the bonds issued to cover the cost of both the aqueduct and the electrical power.

The people of the city of Los Angeles will, therefore, eventually become the absolute owners, without cost to them, of one of the largest municipal water systems of the world, together with the electrical power and the income from the sale thereof, after the payment of the bonds.

WESTERN LAWS OF ELECTRICITY AND WATER

IRRIGATION DISTRICTS.

BY A. E. CHANDLER.

Irrigation Districts in Colorado and Idaho

As shown by the above table from the Census report, both Colorado and Idaho have been active in irrigation district enterprises. It has been stated above that the irrigation districts in Idaho must be reported upon by the state engineer. The wisdom of such a provision and the dire need of it in Colorado is clearly shown by the following extract from the Biennial Report of the State Engineer of Colorado for 1909-1910:

> It is believed that the organization and financing of irrigation districts should be subject to some sort of state control. The present irrigation district law, while facilitating the formation of mutual enterprises in which each man in securing the irrigation of his own land helps to irrigate that of his neighbor, unfortunately lends itself to the manipulation of shrewd and unscrupulous promoters who do not hesitate to take advantage of ignorance on the part of many landowners with regard to financial and engineering problems to promote districts which may or may not have within them the elements of success.
>
> The experience of the State Board of Land Commissioners during the past two years, in which this Board has found it necessary to cut in two in many cases the areas proposed for irrigation under the Carey act, indicates that a similar regulation and control of irrigation districts would be for the good of all concerned. The irrigation district law should be so modified that no issue of bonds for construction purposes can be made until the enterprise has been approved by the State Board of Land Commissioners. From now on this Board will always have an engineer as one member. It can, furthermore, always command the services and assistance of the state engineer's office in any investigation which it sees fit to undertake. It is, therefore, believed that it is the proper official organization to exercise control over irrigation districts.

The 1909-1910 Report of the State Engineer of Colorado contains statistical data for seventeen irrigation districts, voluntarily furnished by the district secretaries. The 1909-1910 report of the state engineer of Idaho contains reports showing the existing conditions of fourteen districts—which reports are made by the district officers to the state engineer in accordance with a provision in the district act.

The suggestion quoted above from the report of the State Engineer of Colorado should be incorporated in the district act of every state, although, as stated, Idaho, Oregon and Wyoming provide for reports on the feasibility of the projects by the State Engineer. The 1911 amendments in California are designed to give existing districts so desiring a financial standing and do not provide for an examination on the part of the state before the organization. The reason most generally given for the failure of the early districts in California was the lack of proper supervision although the fact that the movement was premature and attended by the difficulties incident to rapid colonizing of new territory was an important contributing cause of failure.

Advantages and Disadvantages of the District Organization.

When the first irrigation district act was passed in California in 1887, the only large irrigation enterprises existing were those owned by corporations (the so-called commercial enterprises) delivering water to landowners having no interest in the works. A novel feature of the district plan was therefore the provision for community ownership. The status today is different. A large number of the commercial enterprises have become mutual or co-operative (that is, the landowners own the irrigation works) and the extensive projects now being operated or constructed under the Carey Act and the Reclamation Act will ultimately be managed as mutual enterprises. The district act is therefore no longer unique in this respect.

Owing to its compulsory provisions it is easier to organize a large project under the district act than to form a mutual company for the irrigation of the same land. The irrigation district has, furthermore, a political prestige unknown to the mutual enterprise and has, therefore, far greater chances of securing favorable legislation.

At present the great obstacle in the way of further development by irrigation districts is the difficulty of financing them. In this the district is also not unique as other forms of irrigation enterprises have the same difficulty in securing money for construction purposes. The argument is often made that school districts and municipalities which depend for their existence upon the irrigation district, have no difficulty in selling bonds while those of the irrigation district go unsold. Bankers and bond houses answer that it is due simply to a lack of confidence: that many irrigation districts and other irrigation enterprises have failed while there are few cases of school district and municipal bonds proving bad investments. As stated above, an attempt has been made to remedy this trouble in California by legislation, but the general view is that no amount of legislation can increase the sale of bonds or increase the confidence in such, and that the only way of proving to the bond-buying public that the security is good is to show a number of successful irrigation districts.

Two states, Idaho and Oregon, have provided for the use of the funds of the United States Reclamation Service in lieu of part or the whole of a bond issue. There are certain legal obstacles in the way of the use of the "Reclamation Fund" for such purposes, even if there was a present surplus of money in such fund. The Reclamation Act provides that no water can be furnished to an individual owning in excess of 160 acres and also that the water user must be a resident upon or in the neighborhod of the land irrigated. An irrigation district organized under such restrictions would not be legally sound. It will be necessary, therefore, to eliminate the above restrictions from the Reclamation Act before the Reclamation Fund can be

used to finance irrigation districts. Furthermore, at the present time the fund has been entirely allotted to regular Reclamation Service projects so that no relief from such source is in sight for the irrigation districts.

Owing to the difficulty in disposing of irrigation district bonds at the present time—especially in California—the irrigation district has to pay far more for its construction work than it should. As the bonds carry but five per cent interest and must be sold at par, the ordinary way of handling both bids for the purchase of bonds and bids for construction work is by means of a combination between contractor and bond buyer whereby the bond bnyer buys the bonds at par and is reimbursed by the contractor who adds twenty or more per cent to his usual contract price. It cannot be claimed, therefore, that one of the first aims of the irrigation district act—that is, the saving of the profit of the middleman—has been brought about. Until irrigation district bonds are on the same basis as other municipal bonds, there will be little economy in the construction of such work.

The irrigation district act provides that the districts shall have the power of condemnation and this provision in the California act has been considered favorably by the United States Supreme Court (Fallbrook Irrigation District v. Bradley (164 U. S. 112). In California and a number of other Western states it is generally believed—although not so specifically held—that only public service corporations have the right of condemnation and that, therefore, a mutual irrigation company or a commercial enterprise for the irrigation of a large body of land for subdivision purposes would not have such right. (Although a digression, the point is here suggested that as the California legislature in 1911 passed a statute providing that "Irrigation in the State of California is hereby declared to be a public necessity and a public use, and the power of eminent domain may be exercised on behalf of such public use * * *," it is high time for a test case to be made by an irrigation company other than a public service corporation. There seems to be no good reason why a mutual company or a commercial enterprise irrigating a few thousand or more acres should not have the right of eminent domain as an irrigation district has.)

Aside from its power of eminent domain, the main advantage of the district organization is the authority of the majority to force the unwilling landowners to enter an irrigation enterprise. This power of the majority and the fact that (in most states) all voters within the district, whether property owners or not, may vote on matters pertaining to the management of the district, is thought by many to be detrimental to the best interests of the district. It is thought that under such conditions the management of the districts is likely to fall into the hands of politicians rather than the more able business men of the district. As to the compulsion exerted to bring unwilling landowners into the districts, this is now of less importance as the interest in irrigation is so great at the present time that there is little objection in any district to its formation and therefore this advantage is more theoretical than real in a number of instances.

SCHEDULE OF HEARINGS BEFORE CALIFORNIA RAILROAD COMMISSION.

August 13, 2 p. m. App. 142—Coast Counties Gas & Electric Company, for permission to purchase the capital stock of the Gilroy Gas Works; before Commissoner Thelen at Gilroy

August 14, 10 a. m.—Case 284—Betts v. People Water Company; before Commissioners Loveland and Thelen at San Francisco. At 2 p. m.: General Order 26—Governing clearances and construction at crossings of railroads, etc.; before Commission in bank at San Francisco.

August 15, 10 a. m. Case 282—City of Berkeley v. Southern Pacific Company; before Commissioners Thelen and Gordon at Berkeley.

August 16, 10 a. m. App. 147—Mt. Konacti Light & Power Company. App. 162—James A. Gunn Jr., for certificate of public convenience and necessity, Kelseyville, Lake County; before Commissioner Loveland at Lakeport.

August 17, 10 a. m. App. 144—Tulare Big Four Electric Railway Company, authorizing issue of capital stock, par value $35,000; before Commissioners Eshleman and Gordon at Tulare.

August 19, 10 a. m. App. 169—Southern California Mountain Water Company, permission to sell, etc. Case 261—Palmer v. Southern California Water Company; before Commissioner Eshleman at San Diego. App. 154—Los Gatos Ice, Gas & Electric Company and Pacific Gas & Electric Company, authorizing the sale by the former to the latter of its entire property; before Commissioner Loveland at Los Gatos.

August 20, 10 a. m. App. 173-174—Southern Pacific Company and Atchison, Topeka & Santa Fe and other companies, re-contract joint use of line; before Commissioners Loveland and Thelen at San Francisco. At 8 p. m.: App. 89—Raymond Telephone Company, to increase rates between Raymond and Pines; before Commissioner Gordon at Raymond.

August 21, 8 p. m. App. 71—W. H. Moffett & Sons, for permission to raise rates in Lemon Cove; before Commissioner Gordon at Lemon Cove.

August 22, 10 a. m. App. 118—James A. Murray and Ed. Fletcher, to increase water rates to county of San Diego; before Commissioner Eshleman at San Diego.

August 23, 10 a. m. App. 55—Imperial Telephone Company for permission to increase rates in Imperial County; before Commissioner Gordon at El Centro.

August 26, 10:30 a. m. Case 264-266-270—San Mateo County Development Association, Chamber of Commerce. Palo Alto, W. E. Bean v. Southern Pacific Company, re-pass rates, before Commissioners Loveland and Thelen at San Francisco.

August 27, 3 p. m. Case 269—Phillip Duffy to define territory served by Napa Valley Electric Company; Pacific Gas & Electric Company v. Great Western Power Company; before Commissioners Gordon and Thelen at San Francisco.

September 2, 10:30 a. m. App. 112—Southern Pacific Company to cancel commodity rates; before Commissioner Eshleman at San Francisco.

September 3, 10 a. m. Case 293—Applications of various public utilities for permission to deviate in certain classes of cases from published schedules; before Commissioners Eshleman, Thelen and Edgerton at San Francisco.

September 4, 10 a. m.—App. 136—Santa Clara Water & Irrigating Company, for order to increase rates in Ventura County; before Commissioner Edgerton at Ventura.

September 5, 10 a. m. Case 274—Pacific Gas & Electric Company v. Great Western Power Company; before Commissioner Thelen at San Francisco.

September 6, 10 a .m. Case 253—Absorption of storage charges; before Commissioners Eshleman and Edgerton at Los Angeles. App. 64—Petition for rehearing by Western States Electric Company before Commissioner Thelen at San Francisco.

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POWER AND GAS

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The International Engineering Congress

Charles C. Moore, President of the Panama-Pacific International Exposition, addressed the Engineers' Club of San Francisco at the Palace Hotel last Tuesday noon. As the event to be celebrated in 1915 is that of the accomplishment of the world's greatest engineering feat, timely and enthusiastic planning for the great international engineering congress of 1915 would but bespeak the world-wide engineering interest in this event. Western engineers are making considerable progress in the pledging of a ten-thousand-dollar guarantee to the great national engineering bodies as a token of western confidence in the successful outcome of the proposed world's engineering congress.

It is now none too early to go after the detail planning of the great event. The lively and active planning of the committee appointed by the American Institute of Electrical Engineers in formulating the International Electrical Congress for 1915 may well be emulated by those having in charge the general engineering congress for that year. Great bodies move slowly and it has been said on more than one occasion that even the "mills of the gods grind slow and exceedingly small." A little Western engineering gunpowder, however, like boarding house butter, goes a long way. It is to be hoped that immediately upon the proposed guarantee being assured a unified and emphatic western protest will be made to the eastern engineering bodies to take positive and complete action in the matter.

Telephone Versus the Power Line

In the modern, rapid rise of the great industries many things have entered with dark and ugly features to warp out of proportion or else to delay the ultimate advance of the engineering art.

The building of great smelters to handle our undeveloped mineral resources has resulted in a district-wide outcry from the agricultural interests circumscribing the smelter-plant. Indeed so determined, and in many cases so just, has been this protest that the courts have seen fit to permanently enjoin the operation of the smelter. The result is that large sums have been expended and are even now being expended by the Federal Government and by the interests at stake, to completely solve and do away with the smelter smoke nuisance. All parties to the issue, in fact, fully appreciate that the real solution of the difficulty is not by injunction but by putting to a useful application the enormous waste products belching forth from the smelter stacks instead of allowing them to devastate in many cases thousands of acres of productive agricultural land.

Now comes the annoyance to telephone lines from the electro-magnetic effects of near-by power lines. The rapid rise of long-distance transmission following quickly upon the phenomenal growth of the rural

telephone has brought about a dangerous situation.

In the early days of the city traction lines the grounding of the telephone return brought about serious inductive difficulties. This was met by the telephone companies in their establishing of complete metallic circuits. The interference of the long-distance transmission with the telephone lines may be said to be completely solved in certain special instances. These instances largely comprise the cases in which the telephone line and the power transmission line bear definite and symmetrical juxtaposition relative to each other and to the earth. Under such circumstances inductive effects may be mathematically calculated and proper allowances made for them. The recent advent of the electrically operated pump for the arid West, however, introduces new inductive complications. The modern up-to-date farmer must have not only his electrically operated pump and all the other household niceties and comforts which the power company is able to supply, but the rural telephone seems also to have become as staple as the milk and vegetables which supply his daily table.

Forty acres and less seem to be the economic unit for intensive cultivation in the West. In supplying the power necessary and the telephone service demanded by the farmer, it is seen at a glance that the net-work of power and telephone wires crossing and recrossing each other in ever-changing variations covering our entire rural communities, is introducing inductive complications of so serious and so perplexing aspects that only the deepest study and scientific investigation can ever successfully solve.

The telephone and the electric power supply may now be well said to be indispensable in the economic development of the great arid West. Not only are the gigantic fortunes invested in these securities at stake but the growth of our rural communities demands that this problem be solved. Some may say that like the "lion and the lamb," the telephone and the long-distance transmission line can never be made to lie down together except in wild imagination or in biblical prophecy.

If such pessimistic conclusions had held sway in former dark and foreboding situations many of the now famous engineering accomplishments would never have been brought to realtiy.

The people of the great State of California have recently endowed their railroad commission with complete authority to regulate and adjust the problems arising between public utilities if in their opinion a risk of life and property is at stake. Several protests are now on file with the commission relative to the power line and telephone difficulty. The problem is one that cannot be hastily set aside or ruled upon. The California commission has already shown by its manly and fearless attitude that every interest of the people and the public utility is to be safeguarded. Here now is a problem affecting the great public utilities and every telephone user in the West. Undoubtedly a permanent solution of the difficulty may be accomplished under proper scientific investigation at this time, for conditions are new in the West and exceptional opportunities are offered for scientific experiment.

The attitude of the commission in disposing of the telephone protest against the power transmission lines will be interestingly watched by not only the people of California, but indeed it may be said by the electrical world at large.

The Growth of High Voltage Transmission

In the issue of this Journal of July, 1896—only sixteen years ago—appeared a description of the Big Creek Power Transmission, touched upon elsewhere in this issue under a description of the present holdings of the Coast Counties Gas & Electric Company. As unfolding the unprecedented growth of the electrical transmission art, it is interesting to quote a paragraph from this article of sixteen years ago:

> For some time it has appeared to the electrical engineers of the Pacific Coast that the energies of the transmission department of the Westinghouse Electric & Manufacturing Company have been centered in the great undertaking at Niagara Falls for the reason that during the past three years the Westinghouse Company has accomplished practically nothing in the way of long-distance transmission in the far West, although actively engaged in the middle and eastern states. It is true that the Westinghouse Company was the pioneer concern to engage in transmission undertakings on the coast, as the interesting installations at Portland, Telluride, Bodie and Pomona attest, and it is possible that no single installation gave a greater impetus to electrical transmissions than did the successful achievement of the Westinghouse Company in the San Antonio plant in stepping up to 10,000 volts for long distance transmission purposes. Of late, however, the influences of the company have again been making themselves felt in this sphere, for it has now not only installed the transmission plant of the Big Creek Power Company of Santa Cruz, Cal., but will shortly place in operation the plant of the Central California Electric Company, extending from Newcastle to Sacramento and employing the *unprecedented potential of 15,000 volts.*

Baldwin and Burt of San Antonio Canyon fame, a score of years ago astonishing the world with their 10,000 volt, twenty-mile transmission, could hardly have dreamed of recent strides accomplished.

With the new Big Creek Power project now being constructed some sixty miles east of Fresno by the Pacific Light & Power Company of Los Angeles, even recent high voltage success is to be completely eclipsed. Power from this project is to be transmitted 275 miles into Los Angeles at a voltage between 150,000 and 175,000.

The only factor which seems now to impede the ultimate high limit of voltage transmission seem to be that point at which the break down point of air takes place, so remarkable has been the march and progress of the suspension insulator. In climates such as California produces we may confidently expect later transmission enterprises to go even higher than the Big Creek project of the Pacific Light & Power Company as all conditions seems to indicate that 200,000 to 250,000 volts may be safely utilized in high tension transmission.

PERSONALS.

G. M. Murphy, manager of the storage battery department of Pierson, Roeding & Co., is visiting Los Angeles.

V. R. Norris, manager of the Arizona Electric Company at Phoenix, Ariz., is enjoying a two weeks' vacation at San Diego, Cal.

C. B. Zabriskie, a director in the United Properties Company, with headquarters at New York, is a recent arrival at San Francisco.

J. T. Shaw, an electrical expert connected with the State Railroad Commission, has returned to San Francisco after a summer vacation.

John S. Baker, district manager of the Crocker-Wheeler Company, is visiting Los Angeles, where the company now has a branch office.

Sidney Sprout, consulting engineer for the California-Oregon Power Company, has returned to San Francisco from the Klamath River region.

Rudolph W. Van Norden, consulting electrical and hydraulic engineer at San Francisco, is making an engineering examination in Northern California.

John M. Gardiner, who has lighting and electric railway interests in Southern California, arrived at San Francisco from Los Angeles during the week.

F. B. Gleason, manager of the Western Electric Company's San Francisco branch, has returned to San Francisco after visiting New York and Chicago.

William Clayton, general manager of the John D. Spreckels interests at San Diego, including the San Diego Electric Railway Company, is a San Francisco visitor.

Clarence Follis, who was for a number of years connected with the Brooks-Follis Electric Corporation, but is now a business man of New York, is visiting San Francisco.

R. F. Oakes, president of the American Ever-Ready Company, San Francisco, is making an automobile tour of the Lake Tahoe region with his family and will be absent several weeks.

J. H. Wise, assistant general manager of the Pacific Gas & Electric Company, has returned to San Francisco, after an inspection of the work in progress on the new South Yuba development.

Frank W. Darling, sales manager of the Clay Product Company of Chicago, spent part of this week with the company's Pacific Coast representatives, Stewart-Fuller Company of San Francisco.

H. E. Sanderson, Pacific Coast manager for the Bryant Electric Company, has returned to San Francisco, after accompanying **E. K. Patton**, the Western sales manager, on a tour of Oregon and Washington.

K. G. Dunn, with Hunt, Mirk & Company, arrived at San Diego during the past week to start work on the modern steam distribution system which is to be installed by his firm for the United Light, Fuel & Power Company.

Elmer Dover, president of the Tacoma Gas Company, is in supervisory charge of the Pacific Coast properties of the H. M. Byllesby Company during the absence of **C. E. Groesbeck.** The headquarters will be moved from Portland to Tacoma.

R. Worth, who was for two years district sales manager of the Northern Electric Machinery Company of Vancouver, B. C., has just joined the San Francisco office of the American Ever-Ready Company. He will act as sales director for the Pacific Coast.

Jesse W. Churchill and **J. P. Churchill**, who are the principal owners of the California-Oregon Power Company, with headquarters at Yreka, are at San Francisco on business connected with a new hydroelectric development on which work has been started.

R. H. Sperling, general manager of the British Columbia Electric Railway, Ltd., which furnishes traction, gas and electric lighting services for the city of Vancouver, B. C., is on his way to London. He will spend some time in England, after attending a meeting with his board of directors.

H. V. Carter, president of the Pacific States Electric Company, announces the addition of seven new salesmen to their force, including H. C. Bowers, formerly with the Newberry Benheim Electric Company of Los Angeles, as lamp specialist at San Francisco, and W. L. Ingalls as specialist on pole-line material at Portland.

J. A. Lighthipe, electrical engineer with the Southern California Edison Company; **J. E. Macdonald**, secretary of the Joint Pole Committee at Los Angeles, and **E. R. Northmore**, electrical engineer with the Los Angeles Gas & Electric Company, were among the engineers attending this week's hearing of the California Railroad Commission on the new order regarding overhead crossings.

TRADE NOTES.

The Wagner Electric Manufacturing Company has secured a contract for all of the generators and motors required for lighting power purposes at the new plant of the National Borax Company in Ventura County, Cal.

The H. W. Johns-Manville Company was awarded the contract for the electric fixtures for the ground floor, offices, and the show cases of Hale Bros.' new store at San Francisco. Linolite reflectors will be used in the show cases and Frink direct-indirect reflecting electroliers, with opalescent bowls, for the store and offiec lighting.

COMMISSION HEARING ON OVERHEAD CROSSINGS.

The California Railroad Commission held a hearing on August 14 with regard to its proposed order regulating overhead crossings of power and telephone lines as well as railway tracks. Representatives of most of the large power companies were in attendance to protest against several of the requirements which would necessitate the complete reconstruction of almost all present distribution lines and the commission engineer was authorized to prepare new specifications, the committee ruling that this order would not be retroactive.

ELECTRICAL DEVELOPMENT LEAGUE.

The regular monthly meeting of the Electrical Development League was held at San Francisco on August 13, with an attendance of about 60 members. J. E. McDonald, secretary of the Joint Pole Committee of Los Angeles, spoke of the benefits of co-operation as exemplified by the work of his committee at Los Angeles. W. W. Hanscom read an interesting paper on the electrical equipment of the new temporary city hall. The membership committee reported a total of 152 members to date.

NEWS OF CALIFORNIA ELECTRICAL CONTRACTORS.

The John G. Sutton Company were awarded the wiring for the Geary-street car barns at approximately $8000.

The Pacific Fire Extinguisher Company was awarded the wiring for the Lux school for the sum of $5100.

Bids are being taken on electrical work for St. Ignatius church. Charles T. L. Devlin is the architect on this large job.

At a regular meeting of San Francisco District, Local No. 1, California State Association of Electrical Contractors, Mr. McMean of the Southwestern Surety & Insurance Company, went into a very careful explanation of the compensation and the liability clauses of the Rosebury Act.

The Contractors' and Dealers' Association at a regular meeting passed a resolution to the effect that, after September 1st, all special contractors would carry a card and not work for any one found guilty of peddling a bid, and who did not pay their bills.

Messrs. Hanbridge, Arbogast and Phillips were appointed by the California State Association to assist in getting all electrical work segregated.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

CO-OPERATION AMONG THE ELECTRICAL TRADES.

BY ALBERT H. ELLIOTT.

You have been told so much about co-operation that I imagine you thirst for new ideas and a new method of presenting them. It is with some hesitation that I come before your convention to preach the same old sermon in the same old way. The idea is as fundamental as the Ten Commandments. It is as simple and as easily understood as the addition of numbers. Why, then, do we keep repeating these simple things? The answer is that we do not always practice the things which are obvious and which we know to be sound, and we shall keep on with the process of education until at least a large majority of those engaged in the same line of business shall come to see the light.

We have no schools and colleges in which those engaged in the electrical business can be educated in the simple great economic truths underlying their business. For the present, associations and their conventions and meetings must do the work. You are to listen, then, for a few minutes to a lecture which has for its subject a very simple theme, and I shall try to present it in a simple manner.

The process by which raw material is taken from the ground, wrought into electrical goods by the skillful fingers of the manufacturer, transported in bulk quantities to the jobber, spread on the jobber's shelves where the contractor may pick and choose, placed by the contractor in the home or business building of the ultimate consumer—this process is a great fact, as old as the laws of business itself. We did not make this process and we cannot but change it but slightly as the years roll around. So long as we are a legitimate part of the process, we should be satisfied to render our portion of the service by which goods are manufactured and sold.

The channels of trade have been cut in the geological strata of the business world for ages and ages. I think it is fair to assume that the process will go on in the same way for a long time to come—such a long time that there is no use asking the question as to whether this or that branch of the industry shall be done away with. If we are satisfied that the electrical contractor—the man who takes the goods from the shelves of the jobber and installs them—is a part of the channel, so to speak, then we can begin to investigate our subject without fear that we shall be charged with making an aeroplane journey into the light upper air of pure theory.

At the very start I oppose competition—that is, the kind of competition which the word usually connotes—to co-operation. There is competition of service and quality which is not opposed to the idea of co-operation but is a necessary incident of it. Competition in mere price, however, with its expensive armaments and standing armies, is opposed in idea to co-operation for a very obvious reason.

In no part of the process of the creation and distribution of electrical goods does there seem to be room for the suggestion that the goods can be sold for less than the cost of production for any length of time without wrecking the entire process. This is one of those simple truths which we must get into our system by a process of repetition. We want every man engaged in the electrical business to be inoculated with it. We want the germ to get into his system, until he breaks out with a rash and spreads the virus to all with whom he comes into contact in his business world.

We want it to work both ways, so that neither will you try to sell goods or do work yourself for less than cost, nor will you ask the other fellow to do it. We want your business itch to be so strong that an uncomfortable irritation will be immediately set up when the idea gets into your heads that you are smarter than the others and can sell goods or do work for less than cost and succeed, where others have failed.

The consumer should not be forgotten, and I want to speak a word for him today. Too often is he forgotten at these business conventions where we are all busy finding out how we can shove more goods at him, at a higher profit. There is no true co-operation which ignores the consumer. Here is another of the simple ideas which will bear repetition. When you find a group of business men putting up a job on the consumer, you can look for as much co-operation as you would find between the Barbary pirates and the crew of a Spanish galleon.

The consumer wants two things above all else—good service and good quality. Of course, the price should be reasonable—that is, a reasonable advance on the actual cost of production. But the consumer demands that his house shall not be burned by your poor goods and your bad installation. He knows that good goods and first-class installation cannot be procured at less than cost. You co-operate with the consumer when you give him "good goods," installed in a first-class condition. You hurt the consumer when you give him bad goods, poorly installed.

If because of a freebooter struggle with your neighbor in business you make up your inevitable losses by cinching the consumer through the simple process of bad material and worse installation, the system of co-operation breaks vitally at its ultimate point. And notice how the break shatters the entire structure.

Where do you get your bad material? You cannot keep up the foolish fight with standard goods, and you begin to hunt around for material that looks enough like standard to fool the unwary eye of the consumer. Here is the second break in the chain of co-operation. Possibly you can find a jobber who will in turn find a manufacturer who will produce the article your are looking for. What a splendid plan it is! So long as standard goods are maintained all the general co-operative structure stands. What a nice little time you are having, even if you do bring in an earthquake now and then. You are content for others to hold up the structure even if you do crack it some. But when it falls, where are you with your pretty plan of chicanery? You are the first to go under, because in a business storm the houses not built upon the solid rock of business probity are swept away.

We must see, then, that real, true co-operation is not a theory, or a mere ethical maxim. I am not preaching a sermon to you—good in convention days, but not to be practiced during the working week. It is the distinction between selfishness and self-interest which should be borne in mind.

Very often a wise man is born into the electrical business. He knows so much better than those who have breathed electric currents all their lives that he wants to show them a thing or two. Like the crank who fiddles with perpetual motion, he must have a demonstration. If any of you think that you are such a wise man—a meteor shot athwart the black sky of the electrical business—get your demonstration before you enter the business. Study the methods of the wisest heads in the American business world today. You may pull a few others down with yourself in your reckless experiment, but we can guaranty that you go down yourself, because the laws of business are as inevitable as the laws of gravity, and if you can prove that goods can be sold at less than cost at a profit, you should be addressing this convention on the subject, "How to 'blow in' profits and not 'blow out' your business."

Co-operation, then, has taken the place of bare-clawed competition. We have progressed far from the jungle days of business. We want to live and let live. Our competitor is not our natural enemy. Business is not made from the backs of others. A rational harmony indicates healthful business conditions.

THE PROPER METHOD TO FIGURE LABOR AND GET RESULTS.

BY L. C. AIMES.

In the installation of the electric wiring in a building, there are many items that have to be taken into consideration, when estimating the amount to be charged to labor. One who has served his time in the electrical construction business, naturally has quite an advantage over the man who figures on the plan of so much an outlet, so much wire per day, so much pipe per day, so much an apartment, or so much a floor.

The first item to be considered, and a very important one, is the location of the job, and how easily you can place your men and material on it. As an example, we are installing the electric work in St. Joseph's Orphanage, a building somewhat inaccessable. We have noticed that our men are occasionally late, owing to the distance and the poor car service. It has also cost us more to place the material on the job than we had anticipated and figured. Therefore we say that location has considerable to do with estimating the labor on a job.

Secondly—The disposition of the architect with whom you are dealing must be taken into consideration; is he a man who will help you out of a difficulty, should one arise, thereby lessening the labor in correcting it, or is he a man hard to deal with, and who will try to unload his own mistakes upon you, and force you to correct them at your expense, thus adding to the cost of labor.

Third—The contractor is another person who should be considered. If he is a man who understands how to put a job through with little delay, and does not necessitate your moving back and forth on the job several times before you can complete your part of the work, you can rest assured that your cost for labor on this job will be the minimum.

The method of construction of the building is an important matter to be taken into consideration when estimating the cost of labor. Sizes of floor joists, double or single flooring, furred or dropped ceilings and the height of ceilings are matters of great importance, and must receive careful attention in the labor charge.

Do not, under any circumstances be guided by the amount of material that may be allowed for any job, because you will soon find that no two contractors use the same methods in constructing buildings, therefore any set rule does not apply.

Do not fool yourself by thinking that you have a system where you can install pipe for 3 cents per foot or wire at ½ cent per foot, for such systems are not to be depended upon, and frequently fail. As I have stated before, no two jobs are alike, and this fact must not be lost sight of.

Take each job as it comes along and go into every detail of it carefully, for if you do not you may be forced to do so at some later date, to find out why your men are so long on the job, or why so much more material is called for after you have started.

Some people in figuring jobs are simply guided by the floor plans and never pay any attention to elevation details or to the specifications about floors, walls or ceilings. Strict attention to these details will nearly always save much labor.

The cost of labor on every job should be figured by at least two persons and more if possible. Each should figure separately, and when finished, they should compare figures. If all figures are the same or nearly so, the average of the three should be used. If any great difference is shown, the matter should be discussed, and each one show in which way he has found his estimate. Discussions of this kind are always profitable, especially upon such an important subject as labor.

I shall now endeavor to give you a short synopsis of the system which I believe to be correct, in figuring the labor on any job. As an example we will take a five-story building which contains thirty circuits, all to be placed in conduits. First number every circuit, and maintain that number throughout the job. Study each circuit carefully, for you will find that no two are alike. Then estimate the length of time it will take to install the conduit for each circuit. Next take up the time it will take to install the feed-pipes. Then take up the amount of time required to install conduit for telephone lines. This takes care of all the conduit and feed-pipes in the building.

Then estimate the time required to pull in the wire for each circuit, also all feed wires.

Then next for consideration, come the switches, switchboards, bells and telephones. The time required to install these should be figured separately. This practically completes the job.

From a labor point of view it is poor policy to furnish your men with anything but the best of material and tools. More time is lost in trying to work up some old junk than would be used in putting in two new ones. Remember that time is money.

Always endeavor to start every job at the right time. Do not start too early, before the job is ready for you, for you will have to kill time waiting for it to get ready. On the other hand it is bad policy to wait too long, and then try and rush the job, for something will be left undone, and you will be forced to go back and do it, which means extra labor—in other words, more expense.

Try and keep sufficient material on every job, to fully complete it, otherwise your men will be greatly handicapped, for you cannot expect men to work without something to work with.

In estimating the cost of labor do not be guided by the amount of labor that the best man you have on your force can perform. The best man you have may not be able to be on every job. It is far better to take a good average man as your base to figure from, and in doing so you will not miss your estimate for labor very far. Bear in mind that all men do not work at the same speed, and as I have stated before, do not always look for the speedy man, for after all it is the careful man that brings in results in the end.

Always make it a point to treat your men with respect, but at the same time do not allow yourself or them to become too familiar, for you will find that in time it is the best policy. You are always in a position to speak sternly if the occasion arises, and you will not hurt the feelings of any one, and they will respect you more for it. Do not let any employe feel that he has a life-job, for just as soon as he feels that way, he will surely take advantage of you, and your labor account suffers.

In selecting your foreman for a job, try and get a man who works steadily and conscientiously. It is not always the man who can perform the most labor that makes the best foreman, but the man who can get concerted action from a body of men. Steady concerted action always brings results.

Another word about material. In calculating the amount of material that goes into a job it is advisable to have some one check over the lists of the estimator, and see that nothing has been left out, for it is chargeable to labor, to have a man coming into the shop two or three times a week for small articles, when a little forethought would have avoided it.

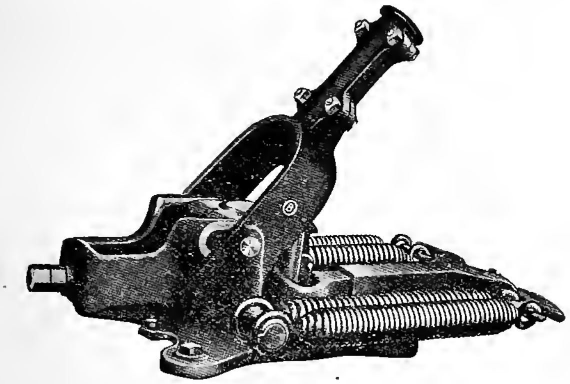
In conclusion, let me say that to get the best results from labor, it is necessary to use judgment in the selection of material, the proper time to place your men on the job, and in the choice of a foreman to run each job. Careful attention to these details cannot help but keep your cost of labor down to the lowest point, and we all know the importance of this.

INDUSTRIAL

O-B TROLLEY BASE.

The Ohio Brass Company of Mansfield, Ohio, has, after thorough service trials, placed on the market the new design of trolley base shown in the illustration. It is very simple in construction and possesses several original features, which make it a valuable addition to the equipment of an electric car.

The tension spring feature, which has proven very popular, has been incorporated in this design in such a manner as to give a very uniform tension on the trolley rope throughout the entire range of movement.



O-B Trolley Base.

The ends of the springs are formed over the cone-shaped ends of eye forgings, giving a substantial construction and reducing to a minimum the possibility of springs breaking. Special sleeve bearings, which may be easily renewed when worn, are provided between the fork casting and the forged rings at the ends of the springs.

The base rotates on improved roller bearings set in a cage so that they may be removed from the base as a single unit. The cage also prevents the rollers from becoming skewed and jammed in the case. For cleaning and oiling the bearings, it is only necessary to remove one screw when the whole mechanism may be lifted off the turret without even altering the tension of the springs. Since it is so easy to gain access directly to the bearings, no oil holes are provided in the casing, and it is, therefore, absolutely waterproof. Renewal of trolley poles in the car barn is greatly simplified by providing a hook for holding down the fork.

Buffing action is provided for by a compression spring and the sliding action of the yoke in such a manner as to prevent bending of the trolley pole and relieve the bearing of all unbalanced strains.

C. B. & Q. RAILWAY EXTENDING ITS TELEPHONE LINES

The Chicago, Burlington & Quincy Railway Company recently placed an order with the Western Electric Company for apparatus to be used in extending its telephone train dispatching circuits. The successful operation of the present lines and the economy resulting therefrom has been the incentive for the extension.

At present, there is a train wire, operated by special No. 102 type selector sets of Western Electric Manufacture, from Kansas City, Missouri, to Napier, Missouri, with the train dispatcher at St. Joseph, thus working the circuit from St. Joseph to Kansas City on one end and from St. Joseph to Napier on the other. The extension will bring the train wire into Council Bluffs, Iowa, from Napier. This branch is now operated by telegraph and it will be simpler to operate the entire line by telephone, than by using a combination.

Fourteen special No. 102 type selector sets will be installed in way stations along the line to Council Bluffs. The dispatchers will be located at St. Joseph. The new line is approximately 95 miles long.

VITRIFIED CLAY BUS COMPARTMENTS.

In the report of the Committee on Electrical Apparatus at the Seattle N. E. L. A. convention favorable mention was made of the use of hollow tile for the construction of bus

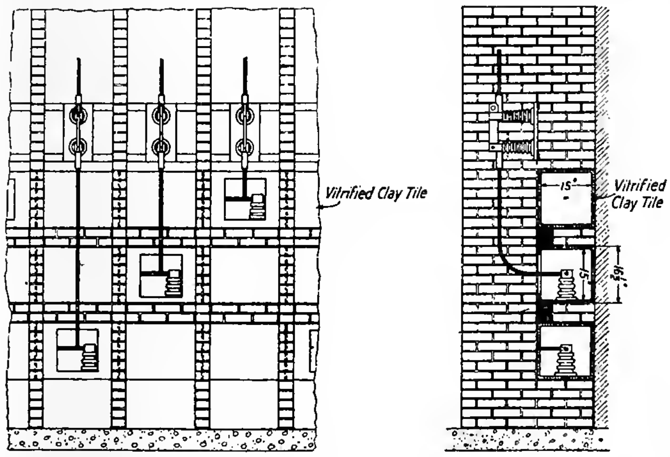


Fig. 1. Vitrified Clay Tile Bus Compartment.

compartments. These structures are so designed that they afford the necessary facilities for bus-bar supports and wiring and at the same time are cheaper and easier to install than concrete or similar materials which are now used for this purpose. Fig. 1 shows the method as proposed.

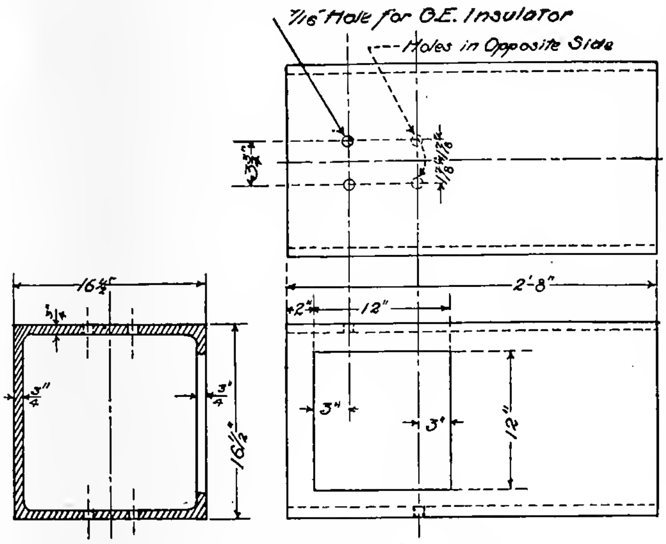


Fig. 2. Details of Bus Compartment.

Acting on the request of Stone & Webster the Clay Products Company of Chicago have designed and are manufacturing such compartments from vitrified clay for use in the Keokuk, Iowa, and Savannah, Georgia, plants, which Stone & Webster are constructing. Fig. 2 shows the detail of this design. The Clay Products Company are represented on the Pacific Coast by the Stewart-Fuller Company of San Francisco.

NEWS NOTES

ILLUMINATION.

ALHAMBRA, CAL.—The City Trustees have adopted an ordinance providing for a street lighting system that will form part of the boulevard from Alhambra to Los Angeles. Concrete lamp posts will be installed.

SAN FRANCISCO, CAL.—For the first time, the Western State Gas & Electric Company turned gas into the large new main on Sutter street last week. Manager W. W. S. Butler states that this is the largest gas main ever laid in this city.

ALAMEDA, CAL.—The City Council has fixed October 15 as the date for the sale of $157,500 of bonds recently voted by the people of the city for improvement in the electric light plant and for a new police signal system.

SAN FRANCISCO, CAL.—The Sierra & San Francisco Power Company has applied to the Railroad Commission for a certificate of public convenience and necessity to operate in the cities of Morgan Hill and Gilroy, and in San Benito County.

WINLOCK, WASH.—A deal has been consummated here whereby the Washington and Oregon Corporation, acquired the electric light plants and systems of the J. Veness Lumber Company, and the O'Connell Lumber Company. The Veness plant is a modern one and the plant of the O'Connell Lumber Company will be rebuilt.

SACRAMENTO, CAL.—The auxiliary electric plaut of the Pacific Gas & Electric Company, which is heing built on the water front a few hundred yards north of the city limits to supply Sacramento with power, should the transmission wires from the hydraulic plant become disabled at any time, is nearing completion. When the building is completed and the machinery it is to cover is in place the plant will represent an outlay of $744,000.

SAN FRANCISCO, CAL.—The Pacific Light & Power Corporation has applied to the Railroad Commission for permission to purchase tangible properties of the Glendale Light & Power Company, consisting of equipment used to furnish light and power to the inhabitants of Tropico. The Pacific Light & Power Corporation states that if permitted to make the purchase it will reduce the price of light and power in Tropico from fifteen to nine cents per kw., that it will reduce the minimum monthly charge from $1.50 to $1, and that it will make all service connections free of charge.

PORTERVILLE, CAL.—Engineers are now working out the plans and work will start shortly on an extension of the Central California Gas Company's system in this city and when the plans have been carried out the mains will reach practically every house in this immediate district. The mains will also be extended outside the city to many of the more thickly settled orchard district. Material is on the way from the mills in the East for the high pressure distribution system, which is to be used for conveying gas to Lindsay, Sharthmore, Exeter and other towns of the east side, all the red tape incident to certificates from the State officials and franchises from the towns having been granted them.

LOS ANGELES, CAL.—The municipality will compete with private light and power corporations for serving other cities. The Public Service Commission has decided on this step and voted to notify Tropico that Los Angeles will submit a bid to the trustees for supplying electricity to that place. The current will come from the aqueduct. The municipality can supply Tropico for 2½c a kw. hour during the on-peak period and at a rate of 70 per cent lower than it can supply itself during the off-peak period. Private corporations cannot meet these figures, it is understood. The light and power supply business of all the cities near by, such as Long Beach, Santa Monica, Venice, Glendale and Redondo Beach, is to be solicited immediately, and it is promised that the current will be flowing in within a few months.

TRANSMISSION.

POCATELLO, IDAHO.—The bursting of a tank belonging to the Pocatello Gas & Power Company caused a loss of $5000.

CLAYBURN, B. C.—The British Columbia Electric Company is considering an extension of its line from this place to Mission City.

ELGIN, ORE.—Fire recently destroyed the Elgin Electric Light & Power Company's plant at this place, causing a loss of several thousand dollars.

PORTLAND, ORE.—Work is to be started soon on the extension of a car line from the present terminus of the Eastmorland line through Errol Heights.

PORTLAND, ORE.—The Hawthorne avenue car line will probably be extended from E 60th and Division streets to E 74th street by the Portland Railway, Light & Power Company.

POTLATCH, WASH.—The Mason County Power Company has been incorporated for $2,000,000 and will huild its plant at this place to supply power to various parts of the county.

CENTRALIA, WASH.—Preparations are being made for building an immense power plant on Packwood lake, in the eastern end of Lewis county. It is intended to develop 100,000 h.p.

SAN FRANCISCO, CAL.—The Railroad Commission has received an application of the Southern Sierra Power Company for a certificate of necessity and convenience to operate in Inyo County.

WALLA WALLA, WASH.—It is reported that an electric line will be constructed from this place to Union, Ore., by W. A. Terrell, of Union, and others. A move has been made to locate a feasible route.

SALEM,. ORE.—The proposal of J. P. Donovan to develop 15 h.p. a the mouth of the Clackamas River has been approved by John F. Lewis, state engineer. The project calls for the investment of $1,250,000.

DIXON, CAL.—An application has been made to the Board of Trustees by the Great Western Power Company for a franchise to erect transmission lines in the town of Dixon. Sealed bids will be received up to 8 p. m. September 10, for sale of said franchise.

FAIRFIELD, CAL.—An application has been made by the Great Western Power Company to the Board of Trustees for a franchise for electric transmission lines in Fairfield. Sealed bids will be received up to 8 p. m. August 27, for sale of said franchise.

WALLACE, IDAHO.—The Kootenai Power & Construction Company is the name of a new company which has been formed by Joseph A. Coram of Boston, to develop power at Kootenai Falls. Forty-five thousand h.p. will be developed. Incorporators are E. E. McWhitney and N. P. Coffin of Wilmington, Del.

SAN FRANCISCO, CAL.—An amended application of the Indian Valley Electric Light & Power Company has been received by the Railroad Commission to issue 100,000 shares of common stock and $250,000 in bonds for the purpose of additional construction, and also to issue promissory notes to the amount of $50,000.

PHOENIX, ARIZ.—Secretary of the Interior Walter S. Fisher has announced that he has approved the power contract between the local Reclamation Service and the Inspiration and Miami mines. Electrical engineer of the Reclamation Service, M. O. H. Ensign, will supervise the drawing of the plans for the transmission line.

EUGENE, ORE.—A power project rivaling that proposed by the Hill interests at Clark Lake in the summit of the Cascades, is nearing completion of the initial section by the building of a tunnel to tap Waldo Lake, likewise near the summit of the Cascades, approximately 40 miles south of Clear Lake. As a power project the Waldo Lake plan contemplates the development of 35,000 horsepower, as compared with 34,000 horsepower, which is the theoretical possibility of the Clear Lake project. The Waldo Lake power plant at Oakridge would be 40 miles from Eugene, the greatest market, as compared with 75 miles for the Oregon Electric's Clear Lake plant.

TRANSPORTATION.

TULARE, CAL.—Sealed bids will be received up to September 3, for the sale of the franchise applied for by the Big Four Electric Railway Company, to construct and maintain a single or double track electric railroad in this town.

SAN FRANCISCO, CAL.—A modified application has been filed with the Railroad Commission by the San Jose Terminal Company, organized to build an electric line from Alviso to San Jose with steamers connecting at Alviso for Sacramento, to issue $650,000 in 5 per cent bonds.

STOCKTON, CAL.—The Stockton Terminal & Eastern Railroad, which has been running for some time between Stockton and Linden, has built a skeleton track to Bellota and begun service to that point. It is proposed to continue the road to Jenny Lind, Calaveras County.

SAN FRANCISCO, CAL.—Treasurer Benjamin S. Guinness of the United Railways Investment Company, announces that the principal and interest of its series H 6 per cent notes of 1908, maturing August 15 next, will be paid by the New York Trust Company, or at the office of the United Railroads of San Francisco on presentation and surrender.

OLYMPIA, WASH.—With the secretary of state has been filed a copy of the resolution adopted at a meeting of the Washington & Oregon Corporation held in Philadelphia, May 7, authorizing and directing the extension of the Chehalis-Centralia Interurban line from the Centralia terminus in Lewis county, by way of Tenino to the southern terminus of the Olympia Light & Power Company tracks in Tumwater.

WATSONVILLE, CAL.—The $100,000 wharf being built at Port Watsonville by the Watsonville Navigation & Railway Company, is nearing completion, and it is thought that the steamer line between here and San Francisco will be put into operation next month. President F. E. Snowden says the electric line which runs from here to the port will be first extended around the Pajaro Valley, and then to interior points, as the business develops. It is planned to run the steamer to San Francisco every two or three days loaded with the products of this section.

PORTLAND, ORE.—Petitions asking the council to grant a franchise for the extension of the Mount Tabor carline from East Sixty-ninth to East Eighty-eighth streets have been circulated in Montavilla and East Mount Tabor, and will be filed today. The petition asks the council to grant the franchise as soon as possible. It is further recited that by agreement with the Portland Railway, Light & Power Company the citizens interested agree to pay $10,000 toward the construction of this extension—one-half of the cost of the work—and that this money has been collected and deposited in trust in the Merchants Savings & Trust Company, subject to withdrawal by those contributing December 1, 1912, unless the extension is in operation by that time.

LOS ANGELES, CAL.—Engineers of the Pacific Electric Company have completed plans for the construction of a tunnel three and one-half miles through the hill from the Hill street depot to an outlet at Vermont avenue. The company is now waiting for favorable action by the charter revision commission giving power to the city council to grant the necessary franchise. The tunnel will enter the hill in the rear of the Hill street station. It will enter grade again in the Arroyo near Vermont avenue, where it is to connect with the westbound lines of the company. The main purpose of the tunnel is to provide a system of splendid rapid transit lines to Hollywood and the beaches and perhaps to Glendale. Burbank and elsewhere. The tunnel's cost will be about $7,000,000 or approximately $2,000,000 a mile.

TELEPHONE AND TELEGRAPH.

WATTS, CAL.—The City Council will receive sealed bids up to September 17th for a franchise granting the right to construct and maintain for a period of 21 years a telephone and telegraph system along the streets of this town.

LOS ANGELES, CAL.—The American District Telegraph Company will have to obtain a franchise and pay two per cent of its gross receipts each year for the privilege of doing business in Los Angeles. The new franchise will compel the company to remove its wires from poles and place them in conduits.

WILLIAMS, ARIZ.—J. C. Griffith, general traffic supervisor of the Mountain States Telephone & Telegraph Company of Denver, Colo., was in Williams recently looking over lines acquired by the company, and extensive improvements in telephone service in northern Arizona will be made by the new company.

PORTLAND, ORE.—The Pacific Telephone & Telegraph Company has sought an injunction in the Circuit Court to prevent the Home Telephone Company, the Multnomah hotel and the R. R. Thompson estate from interfering with the telephone service in the hotel. The issue was forced by the Home Company in May, when the concern tied up the four leading hotels of the city in a conditional contract calling for the exclusive use of the automatic phone on the rooms of these hotels. J. C. Ainsworth, who is president of the United States National Bank, is also treasurer of the Pacific Telephone Company. He has been the leader of the interests backing the Pacific Company. Opposed to Ainsworth and the millions of capital affiliated either with his bank or friendly financial institutions, have been, it is said, the Ladd & Tilton Bank, the First National and other allied concerns. W. M. Ladd and A. L. Mills, the former at the head of the Ladd & Tilton Bank, the latter president of the First National, and Theo. B. Wilcox, the millman, are all directors in the Home Company. The result has been that the stock of the Home Company of Portland, which could be bought less than two months ago for $10 a share has now advanced to double and triple that figure. The owner of one block of stock, it is known, has refused an offer of $30 a share, and is holding its shares at $45.

WATERWORKS.

OAKVILLE, WASH.—Sealed proposals will be received August 19th for furnishing materials and constructing a waterworks system.

WENATCHEE, WASH.—At Leavenworth the people will vote August 20, on the issuance of $44,000 in bonds for inaugurating a new water system. A new sewer system is also planned.

SIERRA MADRA, CAL.—The Board of Trustees will receive sealed bids up to September 12th for a franchise granting the right to construct and maintain water mains and laterals along the streets of the town.

ALPHABETICAL INDEX TO ADVERTISERS

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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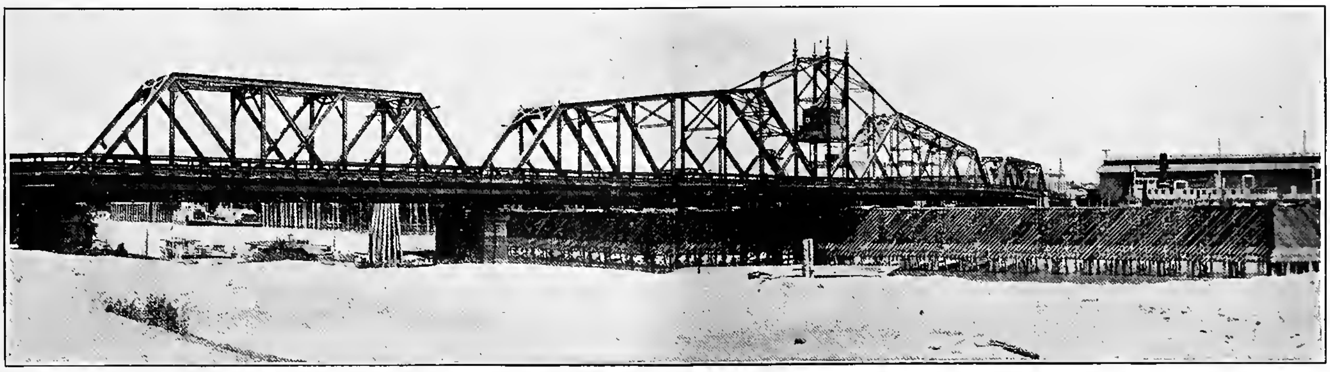


Steel Drawbridge Over the Sacramento River. Steamer "Capital City" on the Right.

THE SACRAMENTO AND WOODLAND RAILROAD

BY RUDOLPH W. VAN NORDEN.[1]

The electric railway, that inevitable stamp of progress, the evidence which is in itself both a cause and effect and which is now looked upon the world over as the talisman, is slowly but surely weaving its web up and down and across the Sacramento Valley of California.

This valley, perhaps the most fertile, and certainly one of the richest in potential values in America, has suffered for want, not only of cultivation, but of rapid and easy means of communication to make cultivation possible. Not that many parts have not been cultivated to the highest degree, for the bottom lands have been reclaimed and farmed to a high state of perfection for many years and in fact the entire valley is wonderfully productive, but the future possibilities are indeed great.

Already the Northern Electric Railway has shown, in its success physically and financially, what can be expected, and the projected feeder, the Vallejo & Northern and its forerunner which is now an accomplished fact, the Sacramento & Woodland are but threads in the interurban network which is bound to develop rapidly.

The Sacramento & Woodland covers one of the oldest and richest farming sections in the state. Its route through orchards and hop vines and along the cottonwood bordered river is picturesque in the extreme. The new road supplies a crying want for transportation. It is well designed and constructed and should mark a milestone in the forward progress of the section tributary to it.

On July Fourth of this year passenger traffic was formally inaugurated although regular scheduled traffic was not begun until the fifteenth of that month. Current was first turned into the electric rail on the second of July and on that day a car was run over the line and return without interruption or accident, but not without incident. The day that this run was made had been a very strenuous one for those in whom the construction work was in charge. There was, even late in the afternoon, much grading to be done, especially at the approaches of the Sacramento bridge; rails to be laid and heavy connections to be made. From appearances, the actual operation of the line seemed at least several days off. But the formal opening was scheduled two days later and there was much to be done in the intervening time to make traffic safe and sure. The work, however, had been well organized and every man was doing his best and the sun had not yet set over the purple Coast Range hills when the first car was on its way. There had been no public announcement, nobody was supposed to known that the car was coming; people must have sensed it somehow, for every ranch and crossroad had its crowd, everyone was cheering and happy, because this, one of the most fertile and highly cultivated districts in California, a district always handicapped however by an absolute lack of any but transportation by teams over necessarily indifferent roads, which was to be finally relieved by not only receiving transportation facilities, but further by a modern interurban freight and passenger service of the highest order. As the terminal at Woodland was approached

[1]Member A. I. E. E., A. S. C. E.

the county road paralleling the railroad was a cloud of dust from the score or more automobiles racing to be the foremost to meet the first car. And when the city itself was reached, the streets with their crowds had the appearance of some street carnival.

Engineering Data.

Beginning at the terminus of the Northern Electric Railway's line at the depot of that company, Eighth and J streets in Sacramento, a single track follows Eighth street southward a distance of three blocks to M street, thence West on M street to the Sacramento River. The line continues on a tangent across the steel drawbridge and then follows its own embankment for a mile after which it curves, taking a northwesterly direction, crosses the main line of the Southern Pacific Company at Mikon and follows a series of tangents, more or less close to the west bank of the Sacramento River to Elkhorn, on the levee bank of the river. From this point the line goes due west, crossing the overflow basin of the river on a long pile trestle and finally continuing with ordinary construction for a flat ground surface. It enters the city of Woodland at the east end of its main business street and continues along Main street to the center of the business section, where the depot is situated on one of the most important corners.

Main Street, Woodland. Depot on the Left.

The length of the line from the Sacramento to the Woodland depot is 17.93 miles. The length within Sacramento is one mile. Here a standard paved street construction is used, the trolley is the catenary type, the wire being No. 0000 deep-grooved copper and the track is equipped with 114 and 116 lb. "Trilby" deep girder rails. Just before reaching the bridge over the Sacramento River, there is a spur track which parallels the freight house and river landing of the Sacramento Transportation Company's steamers, also a connection to the tracks of the Southern Pacific Company and in addition a connection with the freight sheds of the Northern Electric Company. The girder type of rail and catenary trolley wire is carried to the bridge on which a standard rail is used with the electric third rail. A semaphore signal at the center of the draw informs an approaching car whether or not the bridge is clear to permit crossing.

The natural level of Sacramento city is not in altitude greatly in excess of the bed of the river and at times of high water is somewhat below the river level. All of the reclaimed districts adjoining the Sacramento River are protected from overflow by levees or earthen embankments high enough to be well above the highest water record. These levees are about 15 ft., above the surrounding country. In approaching the bridge from either side the levees are crossed and the bridge floor is consequently slightly above the top of the levees. In constructing the railroad following the west bank of the river, it would have been possible for much of the distance to have placed the road on the crest of the levee, or, to have built the roadbed in the ordinary manner, on a right of way, back from the levee on the level land. For various reasons, neither plan was adopted, but a private right of way was secured on the most direct line and an embankment, practically equal in height to the river levee was constructed beginning with the west end of the Sacramento bridge, and extending to the pile trestle which crosses the overflow. This was a costly expedient but a wise investment. As before stated, the line follows the river in a general way. The river is very crooked, so that the line cuts off much unnecessary distance; the levees from year to year suffer much erosion from the flow in times of high water, and while they have a high factor of safety from actual break, such disasters have occurred, they therefore require more or less repair, both of these features giving good reason for keeping the track away from the levee crest. In case of seepage or actual break a low track would be flooded; finally the high roadbed is not only a safety factor towards uninterrupted traffic, but should a levee break, the embankment is amply strong to withstand the flood from the river, thus acting as a second levee without interruption of service and at the same time saving the land and crops of the farmers' whose land is adjacent and from whom the company derives a portion of its revenue.

Roadbed on Top of River Levee and View Up Sacramento River.

The embankment varies in height from 10 ft. to 20 ft. and is about 50 ft. wide at the base, the top having a width before placing the ballast of 16 ft. This was built largely by contract, the earth being placed with dredgers, or teams and scrapers. There was more or less variation in the cost of this work, but the average cost of placing the earth to the company was 20 cents per cubic yard. There was no rock and the ground is a heavy alluvial soil.

Except on bridges and trestles, a broken stone ballast was laid. This consists of clean crushed boulders from the Natomas crushing plant at Folsom and is the highest grade of rock ballast procurable. This ballast was specified to have a thickness of 8 in. under

Passing Through a Picturesque Hop Ranch. View Shows Various Features of Roadbed and Track Construction.

the ties, or 14 in. in total depth, but actually was placed about 1 in. in excess. The amount of fill in the embankment for the entire road was 1,500,000 cubic yards and the amount of broken rock for ballast is 3000 cubic yards per mile.

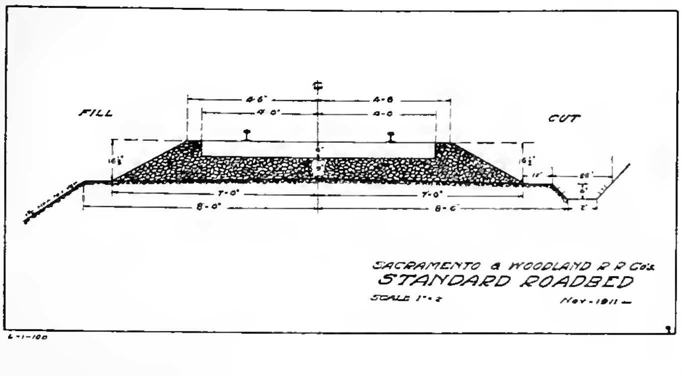
Standard split redwood ties, 6 in. x 8 in. x 8 ft. spaced 15 to a rail length were used, every tenth tie having a length of 10 ft. to provide a fastening for the third-rail chair.

The rails are 60 lb. standard A. S. C. E. profile, with continuous rail joints and 400,000 c.m. brazed bonds.

The electric, or third rail is 48 lb., special high carbon steel, having a much lower resistance factor than the running rails and also having a special profile. This rail is mounted on standard Northern Electric chairs, a type designed for and used exclusively by that company. They consist of a malleable iron base and clamp top which engages the rail, the base and top being joined by an impregnated wooden block insulator.

At all road crossings, the third rail is discontinued, the blank ends being terminated with a point to readily pick up the contact shoe on the car truck. Wood cattle fences are provided and Kalamazoo perfect sheet steel cattle guards are used. The right of way is fenced on both sides with a 4 ft. rabbit proof galvanized wire patented fencing.

The electrical continuation of the third rail over crossings is made underneath the crossing by 750,000 c.m. rubber-covered cable laid in iron pipe. This conduit is brought up to a pothead at each end, which stands at about the level of the rail. This pothead is filled with insulating compound and makes the crossing perfectly watertight. The cable from the pothead is soldered directly to the rail.



After leaving the river, the embankment is carried to the "back levee" a distance of about 1½ miles. This protects the reclaimed cultivated land from the overflow of the Sacramento River.

There was a time during the early settlement of the state, and before hydraulic gold mining operations were commenced in canyons of the Sierra Nevada mountains, on rivers tributary to the Sacramento, when the channel of that river was of sufficient depth to carry its flow between its banks, and there were no levees then. The debris from the mines gradually filled the bed of the river flooding the adjoining country. This prompted the building of levees and the creation of Reclamation Districts. The low lands down the center of the valley probably always carried some overflow water, but when the river became filled with mining debris, it became necessary for the safety of levees below, to relieve flood water in the river by discharging into the Yolo basin, commonly called the "overflow." It was therefore necessary in building the railroad across this basin to provide a pile trestle which would not obstruct this flow, notwithstanding that six or more months in the year the ground under the trestle is dry.

Trestle Crossing the "Overflow."

This trestle follows Northern Electric standards, has eight pile bents and an average height above ground surface of 20 ft. The length is 8000 ft. The remainder of the line is above the flood water level and ordinary ditch and fill construction is used.

Beginning with the eastern limits of the city of Woodland, use of the electric rail is discontinued and a catenary trolley suspended from steel poles on either side of the street for a distance of one mile. The catenary support is Northern Electric Railway type and the trolley is No. 0000 grooved copper.

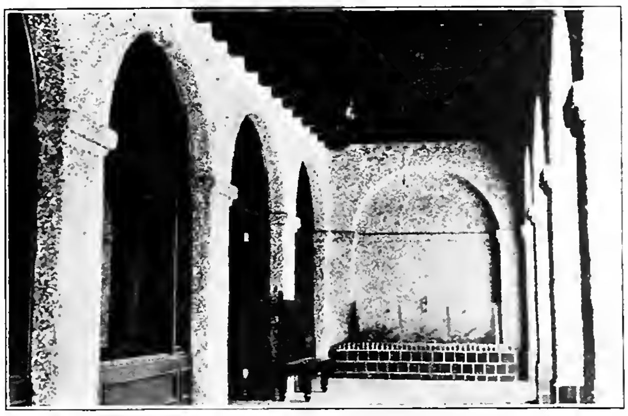
Depot at Woodland Showing Train Ready to Pull Out.

There have been constructed side tracks and spurs wherever necessary for traffic, the total mileage being as follows:

Main Line		17.93 miles
West Sacramento	300 ft.	
Mikon	950 ft.	
Rose Orchard	650 ft.	
Lovdal	600 ft.	
Leeman	400 ft.	
Marty	550 ft.	
Beatrice	500 ft.	
Vin	400 ft.	
Hebron	350 ft.	
	4700 ft.	
or	0.89 miles	.89
Total Mileage, e.s.t....		18.82 miles

Depots.

As before stated, the Northern Electric station is used as the Sacramento terminal. There are at present 9 line stations, each equipped with a plaform and there will be eventually, a number of shelter stations at these points. The only depot at present is at Woodland and this is one of the most elaborate and carefully worked out interurban depots on the Pacific Coast. It is situated on the corner of Main and Second streets in the center of the business section. It is an imposing structure in a modified Spanish Mission style of architecture, of cement stucco on expanded metal.



Mission Arcade Entrance to Waiting Room, Woodland Depot.

The track from Main street enters the building diagonally on the corner, passing through to the storage yard in the rear. On one side are arranged the baggage and express rooms and on the Main street side are the waiting rooms, ticket office and lavatories, the entire arrangement being very complete.

Waiting Room, Woodland Depot.

The main waiting room has a large fire-place in one side and is finished in natural wood. It opens on to a deep arcade which parallels the street and is open thereto.

In the rear of the depot is a storage yard 418 by 113 ft. and containing 6 tracks, giving storage for 30 cars.

There is a Y consisting of a spur track laid north of Main street along Second street, to permit the turning around of cars or trains.

Sacramento River Drawbridge.

The only spectacular or unusual engineering work in connection with the Sacramento & Woodland Railroad is the bridge over the Sacramento River and this might not appear so except to one who was familiar with the preliminary work in building the structure.

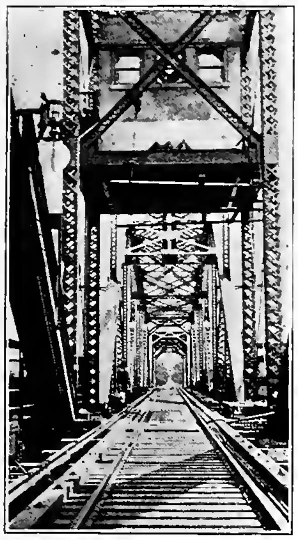
Switch and Storage Yard in Rear of Woodland Depot.

The bridge is of steel and has two fixed spans 125 ft. long and a draw span at the center 400 ft. long. In the center is the single track railway,

having a clearance of 16 ft., on either side of which are roadways each with clearance of 11 ft. and outside of the roadways are sidewalks 4 ft. 6 in. wide. The loading for the railway portion is Cooper's E-40.

There are five concrete piers, two of which are built into the levees on either side of the river, three are in the river, the center one carrying the draw span.

There is no bed rock at this point within several hundred feet of the surface and the ground is sedimentary, being made up of silt from the mines and gravel with more or less clay. This material gives a good foundation provided it has sufficient depth to prevent erosion from the flow at the river.



View of Bridge Floor; Operator's Cabin; the Dome of the State Capitol in the Distance.

Switchboard and Controllers in Operator's Cabin.

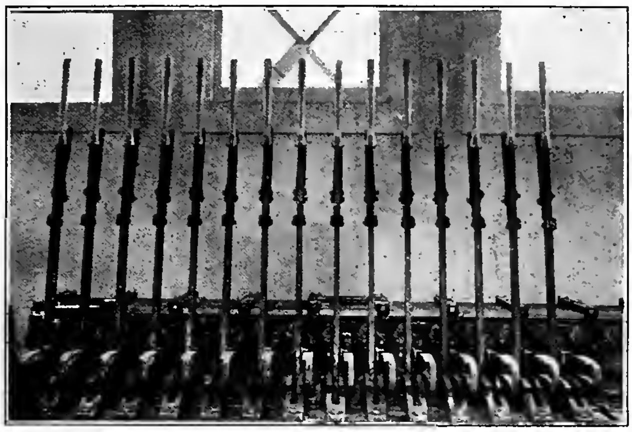
The concrete piers, which are about 100 ft. high and extend below the bed of the river a distance of 60 ft., were placed in excavations made with caissons which were lowered as the excavation progressed. These caissons were constructed of heavy timber and were air tight, the bottom edge being fitted with a wrought iron shoe. In operating they act as if they were giant diving bells gradually sinking. Compressed air under a pressure of 45 lb. to the square inch was supplied within the caisson, this pressure of air being greater than the pressure caused by the surrounding water, served to prevent water and sand from running back into the excavation, meanwhile the material to be excavated was carried by a 6 in. pipe through the caisson and discharged on a barge. As the excavation deepened the caisson automatically followed until sufficient depth was reached. Throughout this work a man stationed at the discharge pipe to prevent boulders larger than a certain size from going through the pipe, practically handled all of the dirt excavated, so it is jokingly said that the pier excavations, 60 ft. below the river bed were dug by hand.

Concrete for the piers was placed by reversing the digging action, the concrete at the surface being confined within sheet piling.

Extending up and down stream from the center pier are pile bulkheads, which act as a protection to the pier from debris, but which were built as a support to erect the draw span.

The upper part of the center pier is cup shaped, i.e. there is a pit 10 ft. deep within it, within which is placed the turning gear, the sides or wall of this pit being a protection from high water in the river. The superstructure is balanced on a roller turn-table whose circular track is placed on the bottom of the pier pit. Outside of this track and within the pit wall is a stationary horizontal gear rack and the movement of the bridge is actuated from this rack.

Over the turntable and directly under the bridge floor are mounted two direct current 60 h.p., 500 volt, d.c. motors. Each is back-geared to a vertical counter shaft through beveled gears. This counter shaft is in turn geared through spur-gears to a second vertical counter shaft, on which is mounted a brake-wheel, and finally this second countershaft is again geared to a third vertical counter shaft, the pinion



Levers for Operating Signals and Gates.

at its lower end engaging with the stationary gear rack. This gives four speed reductions from the motor.

The ends of the draw, when closed, are supported on heavy cast iron plates bolted to the top of the piers. In order that the weight of the draw at the extremities may bear on the respective piers, after the draw is closed, there were provided heavy jack screws. These pass vertically through a huge nut bolted to the bridge structure and drive wedge shaped blocks into depressions in the cast iron pier-plate thus giving the draw a rigid bearing on the pier. These jacks are each driven by a 15 h.p., 500 volt direct current motor, which at the same time moves bolt-rails between the end of the draw and the stationary spans to give a continuous track.

The operating cabin is mounted over the center pier, well above the track. It is 12 ft. square and is built of reinforced concrete, having 4 in. walls. It is reached by iron stairs. In this is a black slate switchboard containing two main switches, one for the bridge motors and the other for the jack motors. These switches have an interlocking device, so that when one is closed, the other must be open and vice versa. Overload circuit breakers and five switches on lighting circuits as well as a jack testing switch are included. In front of the switchboard are placed two railway type controllers used in operating the two groups of motors.

Ranged along another side of the cabin are 15 signal levers, with spaces for 5 more. These operate in-

terlocking semaphores, at railroad crossings on the Sacramento side entrance to the bridge, etc., and operate the gates on the draw and at the ends of the stationary spans.

Power for operating the bridge is supplied through a submarine cable from the Sacramento side, which also supplies current for the road beyond the bridge. This cable built by the Safety Insulated Wire & Cable Company is a single conductor of 1,500,000 circular mils in a strand of 91 wires. The conductor is covered with a 30 per cent Para rubber insulation 9-64 in. thick, which in turn is taped and covered with a 9-64 in. lead sheath. The sheath was then served with jute and armored with one layer of No. 8 and then one layer of No. 4 galvanized steel wire outside of which is placed a jute and sand finish. The cable was laid in two lengths of 650 ft. each, with the aid of a barge, the bridge erecting apparatus and a reel rack with a special chain bridle, the reel being supported on a 4 in. shaft spindle. There are two switch

View Entering the City of Woodland.

boxes on the center pier and one each on the span rest piers, thus dividing the cable in four parts, enabling the cutting out of a section in the case of disablement without interrupting traffic. Taps are taken from the switch boxes on the center pier for operating the turning and jack motors and also for operating a centrifugal pump to be used in case of fire, having a capacity of 600 gal. per minute under pressure of 100 lb. per sq. in. There is also a ten-pair armored telephone cable laid. A loop in this cable is brought up the center pier to a junction box. This is necessary for purposes of testing and for a connection to a telephone in the bridge-tender's cabin.

Train Service and Operation.

This road is now operated as a continuation of the Northern Electric system, and through trains over that system after arriving at Sacramento continue to Woodland. This is found to be a very convenient arrangement both for the railroad and the public. An additional local service between Sacramento and Woodland is provided between the running of the through trains. There are now operated 11 trains each way, of which 8 each way are through.

Dispatching trains is done by telephone, there being a dispatcher stationed at Sacramento and an operator at Woodland. There are a number of telephone stations along the line where conductors may ring in for orders and there are telephones at the two substations. There are two telephone lines, one being purely for dispatching while the other is for general railway business.

The running time for passenger trains over the road is 35 minutes which allows an average elapsed speed of about 30 miles per hour. This time can be shortened by several minutes and it is the intention to do so after the roadbed has become settled.

Rolling Stock.

Cars of the Northern Electric Company being used except for local trains between Sacramento and Woodland, there is a little necessity for car equipment. There is, however, beside construction cars, one combination passenger coach. This car was built in the Northern Electric shops at Chico, Cal., and is modern and of the highest grade of workmanship and conforms to the newest standards of that company. The car is a combination, baggage, smoker and coach, finished inside with inlaid mahogany with veneered ceiling. The seats are plush and leather upholstered and the windows large, giving a full sense of comfort. Enclosed incandescents are used for lighting with tungsten side lights. The exterior is finished in Northern Electric orange and given a high finish. The trucks are equipped with four Westinghouse 121 A., 90 h.p. motors. Westinghouse pneumatic multiple-unit control is installed and Westinghouse automatic air brakes complete the car equipment. The Northern Electric radical draft gear is also used.

This car makes the local round trip between the runs of the through Northern Electric trains.

Substations.

There are two substations, belonging exclusively to this system, one at Woodland and the other, at present a portable, located at Elkhorn.

The Woodland substation is now under process of construction and for the present a temporary structure is used. The permanent station will be a reinforced concrete one-story building, 40 by 60 ft., on the company's property at the eastern limit of the city. It will contain three 250 kw. transformers which receive 3-phase current from the local lines of the Pacific Gas & Electric Company at 11,000 volts and will supply the motors of two motor generators at 2200 volts. These transformers are water-cooled and will be placed in concrete cells. In the main room will be the two motor-generators, the generators being 800 kw. delivering current to the railroad at 600 volts and driven at 514 r.p.m. by two 580 h.p. induction motors. The usual switchboard equipment is provided. The feeders are brought from the substation, underground in two wrought iron conduits which terminate in potheads at the side of the electric rail.

Current from Woodland is carried on a pole line to Elkhorn to feed the portable substation. This was built by the Northern Electric Company at its Chico shops. It is a standard 40 ft. flat car of 80,000 lb. capacity, on which has been erected the station superstructure and within which are mounted the motor generator and a switchboard.

Power for the Sacramento end is supplied from the substation of the Pacific Gas & Electric Company and is the same source of supply as for the Northern Electric Railway.

MONTANA ECONOMICS IN USING CONVICTS FOR ROAD WORK.

An interesting paper was recently presented before the Montana Good Roads Congress meeting at Anaconda by Albert J. Galen, attorney general of Montana. Due to union conflicts the care of prisoners has always been a great burden to this state. The newly devised trusty system, wherein the labor of convicts is used to construct good roads and incidentally give life and hope of parole to the convict has thus far met with unquestioned success for all concerned. An abstract of Mr. Galen's paper is as follows:

It is not the intention or desire of the state board of prison commissioners to interfere with free labor, and I feel that when the various labor organizations learn and understand the character of work undertaken that it will not be in any way considered objectionable. Impartial investigation will convince any fair-minded man of the merits of the present system and the lasting benefits to all classes of citizens. All of the work undertaken and which is now being prosecuted is of general public benefit, and is of such a character that it would not, and could not, be done during the lifetime of any of us, unless by the use of prison labor. Neither the state nor the various counties are possessed of sufficient funds to construct difficult and expensive roads, which in most instances are an immediate necessity. Let us all join in the advocacy of state aid with the use of prison labor in the construction of good substantial roads, and when such roads are completed, let them be turned over to the counties in which they are located, and thereafter maintained and improved by such counties. The maintenance and improvement of such roads after they are built can be readily provided from the ordinary levy of taxes for the road fund in each county. Such highways of travel and commerce tend to upbuild any community; they will attract immigration and settlement more than any other improvement, and without them it is impossible for any community to advance and prosper. They are of benefit to all classes, and more particularly the working man and his family. Good roads add greatly to the industrial activity of any community; they attract investment of capital, and as a result the laboring classes are benefited in larger numbers than others. The laboring classes travel our public highways in greater numbers than others, and where our roads are well constructed the laboring class is thus the greatest beneficiary.

In Montana we have an abundance of good road making material, but generally the first cost of road construction is expensive, because of the topography of the county. The use of prisoners in the construction of public roads in this state has already proven itself a success beyond our most sanguine expectations; and the resulting benefit to the prisoner, physically and mentally, from a humanitarian standpoint, is a sufficient justification for the work undertaken.

The Good Roads Congress held in Billings two years ago and at Missoula last year have done much to give an impetus to good road construction, and this Anaconda meeting is sure to have its beneficial and lasting results. Those of you who have lived in Montana for a number of years realize and appreciate how difficult and expensive it has been in the past to travel our roads, and particularly when hauling freight of any character over the same. We have all witnessed year after year the expense and discomfort incident to bad roads, but until recently there has been no concentrated effort for improvement. I have known of roads in Montana where men with loaded wagons were mired year after year, and on each occasions were only able to extricate their teams and wagons at considerable expense, trouble and loss of time. Yet, notwithstanding such experiences, no effort was made to improve the highways. Each man waited for his neighbor to act, and all waited for the county to make the needed repairs and improvements; but the counties failed and refused to act, because of the lack of funds. With prison labor and at a moderate expenditure, such conditions can be easily remedied; and it is unnecessary to further explain to you the immediate and lasting benefit of any such improvement.

In dealing with the counties under our present method, and in furnishing state aid with the use of prison labor in public road construction, we require each county to enter into a contract similar in terms to the following, which is an extract taken from an agreement recently entered into with Park county for certain road construction in that county:

"In consideration of the mutual benefit and advantages, the county of Park has undertaken and agreed, and does hereby undertake and agree, that it will furnish unto the state of Montana, for use of its prisoners in road construction within said county of Park, all necessary powder, drills, picks, shovels, scrapers, wagons, horses and harness necessary and desirable to be used in proper road construction, including the cost of transportation to and from the place of employment, over and above the sum of fifty (50) cents per capita per day. It being distinctly understood that the state of Montana is to furnish the prison crew at the rate of fifty (50) cents per capita per day, and no greater amount; this representing the cost of maintenance of said crew of prisoners under the terms of this agreement, shall begin at the time the prisoners are moved en route to the place to which they are to be employed, and shall thereafter include the cost incident to the return of prisoners to the state prison at Deer Lodge, Montana, for violation of rules and regulations, and the transportation of other prisoners to take their place."

As before stated, the trusty system of working prisoners in Montana was commenced on April 27, 1910. Since that time the percentage of successful escapes by prisoners has been less than one per cent. The prisoners are placed upon their honor, and generally work willingly and hard. To see them at work in road building one would think they were each being paid $5.00 per day and were afraid of losing the job. In truth and in fact, they are fearful of losing the job. They enjoy this trusty system, and dislike opposition to its continuance; whether emanating from fellow prisoners or other persons. Disobedience to rules on the part of prisoners or escapes, of course, tend to discourage the system; as does also

the failure of juries to punish those who are charged and prosecuted for making escapes. Any prisoner thus trusted who violates any of the regulations, or attempts to escape, is looked upon by his trusted associates with scorn; and the prisoners themselves constitute guards over their fellow prisoners engaged in this work, and most captures of attempted escapes are made by fellow prisoners. The trusty prisoner under our system is allowed ten days per month off of his time in addition to the good time allowance made by law for good conduct and obedience to rules. Now to better illustrate the incentive of the prisoner to be good, let us assume that a man has a term of five years' imprisonment; for good conduct and obedience to the rules and regulations, the law would allow him on such term a deduction of one year and three months, and if he worked constantly upon the roads he would be allowed a further reduction of 120 days in addition for each year of imprisonment. Under the law, if he were entitled to good time because of obedience to the rules and regulations he would only have to serve three years and nine months; and if he were also to work every month on the outside, this term of three years and nine months would be reduced 450 days, so that he would have in fact only to serve on a five-year sentence two years, six months and five days. So, you see, the incentive is great for a prisoner to be good and diligent in his work.

Now let us see what results have been accomplished in this state to date, and the financial advantage thereof. The system was instituted shortly after the prison was taken over from the former contractors, Conley & McTague, although I had advocated it long before. Necessity was aidful in making it a reality, for, on taking the prison over from the contractors, it was found that the state had two hundred more prisoners than cell room. Therefore the surplus number of prisoners had been cared for on the ranch property of the contractors; but when the state took over the management it was confronted with a serious problem. Time would be consumed in the construction of additional buildings, and there was no place to house the extra number of men until the required buildings could be erected; the state was without funds with which to make the needed improvements; and thus, you see, exigency forced our board to take this action, which I believe to have been the wisest act during the administration of Governor Edwin L. Norris. I know that the work will be continued by our successors in office, and that it will always reflect credit upon those by whom it was initiated; and as well, upon those responsible for its continuance. Personally, I shall ever feel proud of the part I have taken in making the trusty system a reality, and I have no apology to make to anyone therefor.

The following statement of mileage of work done in road construction and the cost thereof will be found interesting and instructive:

In Powell County our prisoners have made twenty-four miles of good road at least twenty feet in width, with gravel top and drain ditches on either side; and in this stretch of road they constructed nine cement bridges across various streams; one of which bridges is thirty-six feet in length and eight of them are eighteen feet in length. In addition, on this piece of road, thirty-one cement culverts were moulded and put in place by the prisoners. This work was done at minimum expense, because of the proximity of the road to the prison; and the fact that Warden Conley and his partner, Col. Tom McTague, furnished teams free of charge. The total cost of the construction of all this work to the county of Powell was the sum of $1,336.64. This figure represents the cost of cement, lumber and other material required and furnished; there being no expense to the county other than for materials.

In Granite County, down in the Hell Gate Canyon, seven miles of road was built, two miles of which was rock work. We have no surveyor's figures respecting the yardage on this work, but the rock work was difficult and considerable.

By virtue of this road construction, the distance between Garrison and Missoula was shortened forty miles, and the traveler given facilities for making the trip on a much better and easier grade than heretofore. Prior to the opening up of this road, it was necessary to leave the Hell Gate Canyon and go around by way of Ovando, in order to reach Missoula. This work was done near Bearmouth and Nimrod, and the total cost thereof to the county was the sum of $2,124.75.

In Missoula County four miles of road was built between January and April 1911. There was 8544 yards of rock work and 14,240 yards of earth work done by the prisoners in this road construction, which cost the county the total sum of $1280.31. If this work was done by contract, calculating upon a very conservative basis, the cost thereof would be approximately as follows:

8,544 yds. of rock work @ $1.00 per yard	$ 8,544.00
14,240 yds. of earth work @ 30 cents per yard	4,272.00
Total	$12,816.00

The cost of yardage with prison labor was as follows:

8,544 yds. of rock work @ 9.63 cents, or	$ 823,06
14,240 yds. of earth work @ 3.21 cents, or	457.25
Total	$1,280.31

making a total saving to Missoula County for this construction work by the use of prisoners of $11,535.69.

In Sanders County the prisoners constructed thirteen miles of road between May, 1911, and May, 1912, and shortened the distance in travel between Ravalli and Paradise sixty miles. In the execution of this work they moved 160,000 yards of rock and 38,000 yards of earth. The total cost to Sanders County for this work was the sum of $8798.09. If this work were performed by free labor under the contract system, conservatively estimating rock work at one dollar per yard and earth work at thirty cents per yard, it would figure as follows:

160,000 yds. of rock work @ $1.00 per yard	$160,000.00
38,000 yds. of earth work @ 30 cents per yard	11,400.00
Total	$171,400.00

The actual cost with the use of prison labor was as follows:

160,000 yds. of rock work @ 5 9-100 cents per yard	$8,152.65
38,000 yds. of earth work @ 1 7-10 cents per yard	645.44
Total	$8,798.09

Thus, saving with the use of prison labor on the rock work amounted to 94.91 cents per yard, or a total of $151,847.35, and on the earth work 28.3 cents per yard, or a total of $10,754.56; thus making an aggregate saving to the county of $162,601.91. Theretofore this territory was impassable, and, as stated, by this road the distance between Ravalli and Paradise was shortened sixty miles. Before its construction the traveler was compelled to leave a straight course and go out of his way around by Camas Prairie. The prisoners have been at work in road construction since about the middle of May on the east side of Flathead Lake in Flathead County, but as yet have not received a statement of their work, nor figures regarding the cost thereof.

Park County, as heretofore stated, has entered into a contract with the state board of prison commissioners for a crew of prisoners to be used in road construction, but the prisoners have not, as yet, started work in that county.

For a time a crew of prisoners was employed in Lewis and Clark county, making an approach to the state fair grounds, but I have not obtained figures with respect to the amount of work done and the cost thereof. This work consisted of cutting brush and filling in low swampy ground, graveling the top of the road and fixing an area at the entrance to the fair grounds to be used as an automobile and carriage stand.

In all this road work, please consider that the labor was performed with crude and inferior machinery. We have had very little modern road building equipment, as we have not had the requisite available funds.

THE PACIFIC HIGHWAY.

The full length of the Pacific highway, as its founders plan it, will stretch from the British Columbia boundary on the north to Mexico City on the south.

The third annual congress of the Pacific Highway Association recently passed resolutions inviting the Mexican Government to extend the highway from San Diego southward to the Mexican capital. Other resolutions were:

That the Legislatures of Washington and Oregon appropriate adequate sums for constructing the portion of the highway passing through their territory. California has $18,000,000 set aside for good roads.

That the Federal Government bridge the Colorado River at Yuma and the Columbia River at Portland.

That all Federal parks be thrown open to automobiles.

That $6000 a year be appropriated from the revenues of the association for (1) patrolling the route of the highway and (2) the salary of an executive officer at $3000 a year.

ROAD MILEAGE.

Under a report given out by Logan Waller Page, director of the office of public roads, United States Department of Agriculture, 1911, there was in the United States at the close of 1909 a mileage of improved roads amounting to 2,199,387, or an increase of about 47,000 miles in four years.

SPECIFICATIONS FOR A SANITARY DRINKING CUP.

From the canal zone have come many new ideas on sanitary evolution. The Canal Record of recent date describes a sanitary drinking cup which is easily made from ordinary sheet paper in a few seconds.

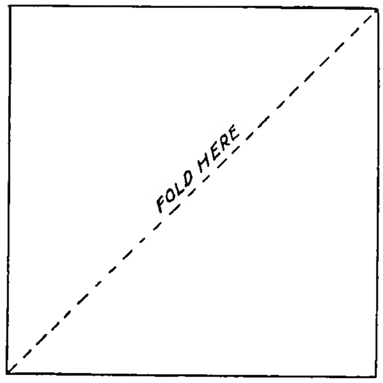


Fig. 1.

To begin with, the paper should be square. If not so, turn over an edge or tear off a strip to make it square. As shown in Fig. 1, fold into a triangle, with edges even. Having once folded, at any stage, do not unfold.

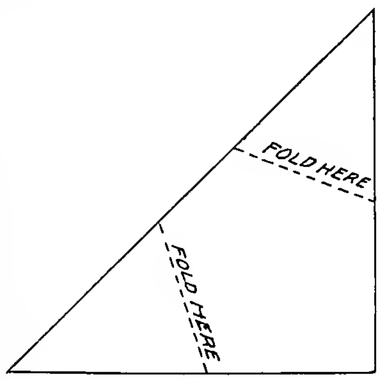


Fig. 2.

As shown in Fig. 2, lay over each of the points at the acute angles of the triangle until it rests near the middle of the opposite edge. The result of this

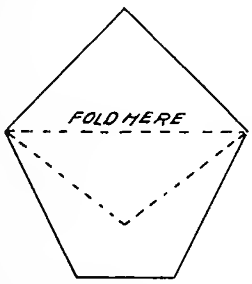


Fig. 3.

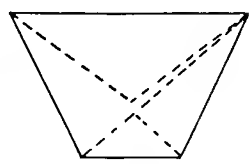


Fig. 4.

folding is outlined in Fig. 3. Fold down the flaps at the top, one on either side, as in Fig. 4, and the cup is completed.

KELVIN MEMORIAL.

The Institution of Civil Engineers of Great Britain has proposed that the engineering profession erect a memorial window in Westminster Abbey to the memory of the late Lord Kelvin, the distinguished engineer and man of science.

THE FACTOR OF SAFETY.

As Called for by the United States Tables of Steam Pressure on Steam Boilers.

REVISED BY J. B. WARNER.

We often see in mechanical papers, and hear engineers and boilermakers remark, that the factor of safety always allowed is 6, and many of them fully believe such to be the case, probably without ever having fully understood the relative proportion between the strength of the joint and solid plate.

The law, adopted in January, 1896, by the U. S. Board of Supervising Inspectors, requires boiler manufacturers to submit a tracing or drawing with the affidavit of material, etc., showing the size and pitch of the rivet-holes in the riveted longitudinal seams or joints, so that the strength or efficiency may be taken into consideration in allowing the working-pressure on all marine boilers.

The rule given below, and Table of Pressures, which has been in use for many years, was adopted before boilers of large diameters and double-welt butt-strap joints of high efficiency came into general use, and applies to single and double-riveted joints only.

Rule.

Multiply one-sixth (1/6) of the lowest tensile strength found stamped on any plate in the cylindrical shell by the thickness—expressed in inches or parts of of an inch—of the thinnest plate in the same cylindrical shell, and divide by the radius or half diameter—also expressed in inches—and the result will be the pressure allowable per square inch of surface for single riveting, to which add 20 per cent for double riveting, etc.

The above rule and U. S. Table of Pressures are based upon, and they assume, in all cases, that the boiler manufacturer so proportions the shearing strength of the rivets and tensile strength of the net section of the plate, that when the joint is riveted up it shall be 58.333 per cent for single riveting and 70 per cent for double riveting of the strength of the solid plate.

How many joints do we find in service having the above efficiency? Very few. Therefore it becomes necessary, in order to determine the safe working pressure and the factor of safety upon a boiler, to know the actual, instead of the assumed, strength of the seam or joint, taking into consideration the thickness and tensile strength of the plate, together with the diameter, pitch, and shearing resistance of the rivets.

By results shown by tests, average iron rivets will shear at 38,000 pounds in single shear, and 66,500 in double shear, per square inch of section; steel rivets, 44,000 pounds in single shear, and 77,000 in double shear. By applying the following rule we get the actual, instead of an assumed result, and will further say that, by a series of actual tests, the result shown was within two-tenths of one per cent of the calculations made previous to the tests, and the joints parted in each case at the point calculated.

Rules for Riveted Joints.

First: Multiply the thickness of the plate by the pitch of the rivets and by the tensile strength of the plate. Result is equal to strength of solid plate.

Second: From the pitch of the rivets subtract the diameter of the rivet hole, then multiply by the thickness of the plate and that result by the tensile strength of the plate. Result is equal to the strength of the net section.

Third: Multiply the shearing resistance of the rivets (whether in single or double shear), as follows: If iron rivets in single shear allow 38,000 pounds per square inch of section, as the shearing resistance. Steel rivets in single shear 44,000 pounds per square inch of section. If resistance in double shear add 75 per cent to the above.

Fourth: Divide the strength of the weakest section by the strength of the solid plate (first result obtained). Result is equal to the percentage of the joint to the strength of the solid plate.

Fifth: Multiply the thickness of the plate by the tensile strength of the plate and divide by the radius (one-half of the diameter). Result is equal to the bursting pressure of the solid plate.

Sixth. Multiply the bursting pressure of the solid plate by the efficiency or percentage of the joint. Result is equal to bursting pressure of seam.

Seventh: Divide the bursting pressure of the seam by the following safety factors: 0 to 125 pounds, 4.2; from 125 to 150 pounds, 4.5; 150 pounds or over, 5 Result is equal to safe working pressure on the seam or riveted joint.

The U. S. Tables are based upon a factor of safety of 3.5 for drilled holes, and 4.20 for punched holes, which are the lowest factors allowed in any civilized country. The factor in most European countries is either 5 or 6.

We often see joints so poorly proportioned that the efficiency is much below that upon which the Table of Pressures is based.

In many cases double-riveted joints are so poorly proportioned that they have an efficiency of only 41 to 53 per cent instead of 70 per cent. In such cases it the pressures allowed by the table were carried in the boilers the factor for safety would be very much reduced.

For example: Suppose we have a boiler 60 inches in diameter, made of ⅜-inch plate, 60,000 pounds tensile strength, and the efficiency of the joint was only 41 per cent, and 150 pounds of steam was carried, the factor of safety would be $.375\times60{,}000\div30=750$ pounds bursting pressure of the solid plate, and $750\times.41\div150=2.05$ as the factor of safety; or, in other words, the seam would burst at just about double the steam pressure (150 pounds). If the efficiency of the joint had been 70 per cent, then $.375\times60{,}000\div30=750$ and $750\times.70\div150=3.5$ as the safety factor, which is allowed under the U. S. Tables for Drilled Holes, and entirely too low a factor for safety.

It is very important, in order to get the ultimate safe working pressure, that the joints should be properly proportioned. Under the old system, a joint with an efficiency of 45 or 55 per cent was allowed the same pressure as a 70 per cent joint. This reduced the factor of safety entirely too low. On the other hand, if a boiler was made with butt-straps, and a higher efficiency than 70 per cent was obtained, no allowance was made for the increased strength, although it may

have cost considerable more. No additional pressure over a simple double-riveted lap-joint was allowed.

The efficiency of riveted joints, if properly proportioned, are:

Single-riveted joint	about 56	per cent
Double-riveted joint	" 70	"
Triple-riveted joint	" 75	"
Double-weld butt joint....... (With four rows of rivets.)	" 80	"
Double-weld butt joint....... (With six rows of rivets.)	" 87	"
Double-weld butt joint....... (With eight rows of rivets.)	" 94	"

There are many styles of joints, and the strength cf each can be determined only by careful calculation.

In most cases, especially on old work, it will be found that the net section (between the holes) is much weaker than the shearing resistance of the rivet or rivets, and, in many cases, a double-riveted joint will be found that does not figure as high as a properly-proportioned single-riveted one would have done.

Applying the rule—Example: Suppose we have a boiler 60 inches in diameter, made of 5/16-inch steel, 60,000 tensile strength, double-riveted with ¾-inch rivets, driven in 13/16-inch drilled holes, pitched 2¼-inch. 2:25×0.3125×60,000=42,187 pounds strength of solid plate: ((2,25—0.8125)×0.3125×60,000=26,953 pounds strength of net section; 0.5185×2×38,000=39,406 pounds shearing resistance of two rivets in single shear.

The net section of the plate is the weakest; therefore, 26,953÷42,187=63.8 per cent efficiency of the joint; 0.3125×60,000÷30=625 pounds, solid plate will burst at; 625×63.8 per cent=398 pounds, the seam would burst at; 398÷3.5=113 pounds, as the safe working pressure under the old rule.

If the same had been .70 per cent, then 625×70÷3:5=125 pounds safe pressure under same rule.

It is much more essential that the seams are properly proportioned than if the tensile strength of the material should fall a few pounds under the required strength as called for in a specification; but, in order tc get the ultimate safe pressure, good material and workmanship are necessary.

In the General Rules and Regulations prescribed by the Board of Supervising Inspectors of Steam Vessels, as amended January, 1912, Form 801, we find on pages 116 to 118 tables of proportions for riveted joints for steam boilers equivalent to those of the British Board of Trade.

These tables are a great improvement over the old method of riveting seams in haphazard manner formerly followed in many boiler shops.

It will be found, however, that if these tables are analyzed, the shearing resistance of the rivets at the pitch (centers) given varies greatly, ranging from 32,686 pounds to 44,500 pounds per square inch of section in the various types of joints given. It is therefore advisable, in order to get properly proportioned joints, that the actual shearing resistance of the rivets be taken into account, or a mean average of the shearing resistance of the iron or steel rivets used be taken into consideration and the joint proportioned accordingly.

PROPOSED CLEARANCES FOR CONSTRUCTION OF CALIFORNIA PUBLIC UTILITIES.

Much discussion has appeared in the columns of the Journal relative to overhead construction of power lines and various crossings of one public utility with another. On August 14, the California Railroad Commission called together represeentatives from all telephone, telegraph, railway and power companies in California to consider the matter informally. As a preliminary form the commission issued the following proposed ruling. After considerable discussion, however, it was decided to call for written suggestions as to amendments from all interested and another hearing to take place in ten days from date. The commission is acting in this matter under authority of Section 42 on Safety Devices of the recent California Public Utilities Act. The chairman of the commission, Hon. Jno. M. Eshleman, was careful to state at the preliminary hearing that the proposed order would in no sense be retroactive except as in such cases danger to public safety was eminent.

Clearances.

1. Railroads, street railroads and streets and public highways, crossing over railroads, and street railroads, which transport or propose to transport standard freight cars, shall provide a minimum overhead clearance above rails of 22 ft., and a minimum side clearance of 10 ft., measured at right angles to the center line of the track; over the rails of street railroads which do not transport or propose to transport standard freight cars, a minimum overhead clearance cf 16 ft. shall be provided with minimum side clearance as before mentioned.

2. Railroads, and street railroads, crossing over street and public highways shall provide a minimum overhead clearance of 14 ft. over the surface of such streets and public highways and a minimum side clearance of 24 ft.; except in cases where such streets or highways carry street railroads which do not transport standard freight cars when such overhead clearance shall not be less thon 16 ft. When such streets or public highways carry street railroads which transport standard freight cars the minimum overhead clearance shall be 22 ft. with clearance as before mentioned.

3. Telegraph and telephone lines shall provide a minimum clearance above the rails of railroads, and street railroads, of 30 ft.; above streets and public highways 25 ft.; above or below other telegraph and telephone lines 2 ft.; above electric trolley lines 5 ft.; and above or below power lines transmitting power at under 750 volts, 5 ft., and over 750 volts, 8 ft.

4. Low potential power lines transmitting power at less than 750 volts shall have a minimum clearance above the rails of railroads and street railroads of 30 ft.; above street and public highways, 25 ft.; above or below telegraph and telephone lines and all other low potential power lines of 750 volts or less, 5 ft.; above or below high potential power lines of more than 750 volts, 8 ft.; and above or below all buildings, structures, wires or other obstructions, 5 ft.

5. High potential power lines transmitting power at over 750 volts shall have a minimum clearance

above the rails of railroads and street railroads of 35 ft.; above street and public highways, 30 ft.; above telegraph, telephone and all power lines, and above or below all buildings, structures, wires, or other obstructions, 8 ft.

6. Trolley wires of railroads and street railroads shall have a minimum clearance above the surface of streets and public highways of 19 ft., except in cases where such railroads or street railroads handle standard freight cars when the minimum overhead clearance shall be 22 ft.; above the rails of all railroads, and street railroads handling standard freight cars, 22 ft.; below telegraph, telephone and low potential power lines of less than 750 volts, 5 ft.; below power lines of over 750 volts, 8 ft.

7. The clearances for wire lines provided in Sections 3, 4, 5 and 6 above, have reference to clearances which will obtain under the most unfavorable conditions of temperature and loading.

Construction of Wire Lines.

8. Where telegraph and telephone lines cross over railroads or street railroads, the span shall not exceed 100 ft. Where wooden poles are used, these shall have a minimum diameter of not less than 9 inches, and shall be securely guyed to prevent wires from unduly sagging.

9. Where power lines cross railroads, street railroads, telegraph lines, telephone lines or other power lines, they shall be constructed to conform to the "specifications for overhead crossings of Electric Light and Power Lines" adopted for the time current, by the Joint Committee of the National Electric Light Association, American Institute of Electrical Engineers, American Electric Railway Association, Association of Railway Telegraph Superintendents and American Railway Engineering and Maintenance of Way Association, except that the clearances provided in Sections 4, 5 and 6, above, of this order shall be observed.

LAMP SIGNALS FOR HOTEL MAIDS.

New applications for electrical energy are each day coming into use more and more. Now comes the lamp signal for hotel maids, as set forth in the Electrical Review and Western Electrician.

An elaborate system of lamp signals for locating the housemaids who care for guests' rooms is in use at the Hotel Radisson, Minneapolis, where the office staff find it of the greatest service in communicating with the various floors. In every corridor at the side of the door of each guest-room is a small 2-c.p. incandescent lamp, and on the wall below is a flush-plate contact jack into which on entering the room the maid inserts a plug carried on her key ring. With the plug in place the little lamp over the door is lighted, indicating from any point in the corridor in which room the maid is working. The circuits from these door lamps are in turn grouped in a signal board in the hotel office, so that the lighting of each room lamp is indicated by its corresponding lamp on the annunciator board. If a certain room is to be made ready on short notice, the maid on that floor can be reached by noting in what room her lamp is burning and then calling the corresponding number over the telephone.

MACHINERY BUILDING AT PANAMA-PACIFIC EXPOSITION.

The Machinery Building, which is to grace the 1915 Universal Exposition, will be the largest of the thirteen exhibition palaces that are provided for in the plans being prepared by the members of the Architectural Commission, and will be the first contract let for the main exhibition palaces. Four heroic statues, representing the personalities who were greatest in the advancement of mechanical arts—Archimedes, Guttenburg, Watt and Edison, will, in all probability, be placed on this building.

NEWS OF RAILROAD COMMISSION OF CALIFORNIA.

The Railroad Commission rendered a decision August 15 granting the application of the Sacramento Valley Electric Railroad Company to issue 30,000 shares of preferred stock of the par value of $3,000,000 and common stock to the value of $750,000. The company proposes to construct an electric railway down the Sacramento Valley, commencing at Red Bluff and running in a southerly direction through Tehama, Glenn, Colusa and Yolo Counties, to the city of Woodland, and thence to the town of Dixon, in Solano County, where it proposes to connect with the Antioch & Eastern Railway. A branch is proposed to run from Colusa to Williams. The estimated length of the whole project is 160 miles.

Subscriptions have been received for 1600 shares of the common stock, of a par value of $160,000, and $16,000 has been paid in cash. The data filed with the Commission indicates that the line will cost exclusive of rights of way, approximately $4,700,000. It is proposed that the common stock shall be used in exchange for rights of way. In its decision granting the application, the Commission requires that construction work shall not begin until there shall be in the hands of the company $750,000 from the sale of stock. This condition is imposed, in the words of the Commission, "in order that reasonable assurance may be had that the actual construction of this road will not be entered upon before there is sufficient money in hand to warrant proceeding with the scheme." The Commission further requires that monthly detailed accounts of expenditures shall be filed with the Commission, and that all contracts for stock sale or construction work involving outlays of more than $1000 shall be submitted for the approval of the Commission before execution.

The Burbank Electric Light & Power Company filed an application for authority to take over the franchise granted to G. H. Deacon by the town of Burbank, Los Angeles County, and to sell stock for the purpose of operating in Burbank. The company has just been organized and has an authorized stock issue of 2000 shares of a par value of $10 per share.

A certificate of public convenience and necessity has been granted to the Great Western Power Company to exercise franchise rights for the distribution of electric power in Petaluma and Sebastopol, Sonoma County.

An informal conference will be held in the office of the Commission on Tuesday, August 27, at 10 a. m., for the purpose of discussing a proposed uniform system of accounts for the gas and electric utilities of California.

The Commission has granted the application of the Half Moon Bay Light & Power Company for permission to operate in the Jefferson School District, in San Mateo County, and of the Coast Counties Gas & Electric Company to purchase the capital stock of the Gilroy Gas Works for the sum of $25,000.

IGNITION OF GAS BY MINIATURE ELECTRIC LAMPS WITH TUNGSTEN FILAMENTS.

BY H. H. CLARK.

The Bureau of Mines has been asked a number of times whether fire damp can be ignited by breaking the bulb of a miniature incandescent lamp in a body of it. This matter is discussed in Technical Paper No. 23 of the Bureau.

This question is of more importance now than at any previous time because of the increasing use of portable electric lamps. The development of the tungsten filament has given a fresh impetus to the manufacture of such lamps, and there are now upon the market several types especially designed for mine service. Portable electric lamps are often used where gas is known to be present, and sometimes, as in rescue work, such lamps must be used where gas (methane) may be present in dangerous amounts.

In connection with its investigations of mine accidents and the dangers attending the use of electricity underground, the Bureau of Mines at its experiment station in Pittsburgh, Pa., has undertaken the study of various matters relating to the ignition of fire damp by electrical equipment. The tests described below were made upon miniature incandescent-lamp bulbs and were preliminary to more extensive tests which the bureau plans to make upon complete portable lamp equipments.

Because of the importance of the question put to the bureau and because of the interest that has been manifested, the following brief review of the test results is published in advance of a more detailed description of the investigation, which will appear in another report.

The tests were made with miniature incandescent-lamp bulbs containing tungsten filaments. The bulbs were supplied to the bureau without cost by the General Electric Company, the Federal Miniature Lamp Company, and the National Electric Lamp Association.

In all tests the filaments were glowing at the moment when the bulbs were broken. One hundred and thirty-one bulbs were broken in a mixture of natural gas (that used in Pittsburg) and air combined in the proportion of 8.6 per cent gas to 91.4 per cent air. These percentages of the gas and air form the most explosive mixture.

Forty-five tests were made in gas-and-air mixtures other than the most explosive. These mixtures contained from 3 per cent to 12.4 per cent of gas. Mixtures containing as little as 5 per cent of gas and others containing as much as 12.4 per cent of gas were ignited by 1.5-candlepower, 3.5-volt, 0.3-ampere bulbs that were smashed while burning at rated voltage.

Tabulation of Results.

Table 1—Bulbs causing ignition at or before rated voltage.

Manufacturer's rating C.P.	Volts	Amperes	Number of tests	Number of ignitions	Percentage of rated voltage causing ignition*
1.0	2.5	0.3	11	7	100.0
1.5	3.5	.3	23	16	100.0
2.0	5.5	.3	9	6	98.7
1.0	2.0	....	9	7	100.0
1.0	2.5	....	10	3	100.0
2.0	4.0	....	10	7	82.2
2.0	4.5	....	10	7	85.3
....	2.0	.73	5	3	94.5
....	4.0	.53	5	5	94.9
....	6.0	.30	5	5	88.2

Table 2—Bulbs causing ignition at more than rated voltage.

Manufacturer's rating C.P.	Volts	Amperes	Number of tests	Number of ignitions	Percentage of rated voltage causing ignition*
0.5	1.5	0.4	10	1	132.7
...	2.0	.23	9	3	120.0
...	2.0	.40	9	3	106.0
...	2.0	.53	6	5	102.0

*The values given in this column are the average percentages of the voltages impressed upon such bulbs as caused ignition.

TESTS ON ELECTRIC HEATERS FOR EXPLOSIONS.

Electric heaters are known to be less efficient and less safe than low-pressure steam or hot-water coils for thawing explosives; nevertheless in certain work electricity is the only available sourse of heat. With this consideration in view an investigation of the heating of thaw houses by electricity was undertaken by the authors in co-operation with H. H. Clark, electrical engineer of the Bureau of Mines, described in technical paper No. 18. The dangers encountered are given in order to promote greater safety in thawing explosives when electric heating is the only alternative. In the tests the steam coils of the bureau's experimental thaw house were replaced with electrical means of heating. The conclusions drawn from the results of the tests are as follows:

Electricity will, under certain conditions, produce sparks and flashes sufficient to ignite explosives or to cause fires that may result in such ignition. It is therefore necessary to select and install heating devices, connections, and circuits with reference to the special service which they are to perform. By far the most unattractive feature of electric heating is the probability of obtaining undesirably high temperatures in the immediate vicinity of the source of heat, and also the certainty that there is almost no limit to the temperature which such sources of heat will attain if the emission or diffusion of heat from them is sufficiently restricted.

Low-pressure steam or hot-water coils and electric heaters have characteristics that are exactly opposite. The rate at which steam coils give up heat is variable, depending upon conditions, whereas the rate at which electric coils give up heat is constant.

The temperature of steam coils cannot exceed a certain maximum, which depends upon the pressure of the steam used, regardless of radiation and convection. There is, however, almost no limit to the temperature that may be attained by an electric heater, and its maximum temperature depends entirely upon those factors that affect the emission or diffusion of heat from the heaters. In this instance the most prominent are the weight of air passed per minute, its temperature, and its specific heat; the mechanical design of the heaters must also be considered.

HIGHEST DAILY STEAMSHOVEL RECORD.

Steamshovel No. 120 (T. P. Kelleher, engineer, and L. P. Bonnell, craneman), working in the west borrow pit for Gatun Dam, on the Panama Canal, loaded 202 large Oliver dump cars containing 3434 cubic yards in the working day of eight hours on July 6. This is 119 cubic yards more than the previous daily Isthmian record for a 70-ton shovel, made by the same shovel and crew on April 2, 1912.

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CONTENTS

The Panama Canal and Sanitary Development

Engineers the world over may well investigate the excellent sanitary precautions taken by the authorities at Panama. This district formerly recognized as perhaps the most unhealthy in the world, stands today as a model in all that goes toward modern accomplishment in disease-preventing and health-giving surroundings. Long since it has been said that the sick and the dying found in the camps of war far exceed those taken from the field of battle. The engineer in his perplexing camp organization has had at times more difficult problems to solve in maintaining his followers in healthy service, equipped with every sinew ready for work, than the actual design of the project.

Many little descriptive ideas are already appearing in the technical press relative to camp equipment and sanitary efficiency at Panama. The little sanitary cup, a description of which appears on another page of this issue, but bespeaks the sanitary evolutions of the Isthmus. Undoubtedly the sanitary accomplishments of the Panama Canal project are today the proudest traditions of that great world-beating triumph.

Boiler Inspection Rules

Much credit is due the various insurance companies for their enterprise in devising ways and means of lessening the risk to life and property. Their zeal in seeing to it that municipalities have proper fire protection has resulted in the evolution of such accomplishments as the high pressure salt water system in San Francisco. The board of fire underwriters in standardizing and devising rules for approved wiring and electrical construction has brought many a small municipality, too poor to have a regularly employed electrician, to a high state of modern proficiency in risk from electric wires.

For many years no particular rules or designs were followed in the construction of boilers. Each factory or boiler shop insisted upon designing and carrying out its own particular ideas in many cases without reference to the most efficient and safe form of construction. These designs when brought under one cover were in many cases conflicting and at times dangerous. The United States government was the first to formulate rules and regulations in 1836. This was later followed up by the various boiler insurance companies. The rules as devised by the Hartford Steam Boiler Inspection & Insurance Company may be said to have now become standard.

The Pacific Coast has shared largely in the credit due this high state of efficiency in boiler inspection and design. J. B. Warner, chief inspector San Francisco department of the above mentioned insurance company, contributes elsewhere in these columns the beginning of a series of articles which bring down to date the latest ideas in rules for boiler design and inspection.

The Pacific Highway

"Good roads for 1915" is the Western slogan of the day. The recent conference at San Francisco wherein representatives from all coast points deliberated as to best methods of boosting the good roads movement and arrive at some effective plan to secure immediate action was interesting in the extreme. The planning of a Pacific Highway having its beginning to the north in Canada, sweeping thence south through the heart of the fertile lands of Washington, Oregon and California, and ending within sight of the Mexican boundary is not that of an idle dreamer, but serious minded men stand ready to give to the project every ounce of attention and effectual promotion necessary for its early consummation.

A discussion of such a gigantic project leads naturally to the consideration of the present availability of the enormous outlay of necessary labor and capital to bring about immediate results. California is already devoting $18,000,000 as a starter in this enterprise and energetic citizens of Washington and Oregon are zealously working to see to it that their neighbor to the south shall not outdo them in their efforts.

Most earnest and convincing dispatches have already been sent to the president of the Mexican Republic by leaders in the movement urging the extension of the project to Mexico City. It is none too early to dream dreams that the future may even see this triumphal highway of the West extended down through Central America on over the Andes to the great Republics of South America and add one more link of brotherhood in thus binding to us the seventy-five million human souls of that promising country.

The Oregon Commission Law

The people of the State of Oregon at an early date are to vote whether or no there shall be a regulating commission over all public utilities within the confines of that great commonwealth. In embarking upon the considerations of commission regulation, perhaps no other factor is so potent for good or bad, as is that of the personnel of those having the drawing up of the enactment in charge.

In California the Public Utilities Act has now been in complete operation for nearly six months and although it is early as yet to draw a complete picture of the far-reaching consequences, yet, in the main, the careful observer cannot help but come to the conclusion that the good results of this law are accomplishing more for the State of California than any other single piece of legislation of the past twenty-five years. Two important factors contributed largely to the success of this commission. The first factor was the careful and studious application with which those fostering the commission idea went about their work. This application ultimately brought forth a law which combines practically all of the good features of eastern regulating commissions. The second factor is that of the personnel of the present commission. The California commission is composed of two middle-aged men and three ambitious young men just on the threshold of life's activity—"the old men for counsel and young men for war." The academic attainments of these young men are of the highest and the university records attest in at least two cases the highest academic standing in their respective graduating classes.

Due to the strong entrenchment of regulating commissions in the larger municipalities of California and their opposition to state-wide control, it was thought best to leave the question of municipal regulation to the local commissions until such time that by affirmative vote of the municipality the state commission would be given authority to act. Unquestionably the wiser regulation is by a state-wide commission. Even now many municipalities of California are either favorably agitating the question of entrusting their utility regulation to the state commission or already have actually passed the necessary measures.

In the passage of a utility enactment in Oregon, the framers of the act would do well to consider the merits of state-wide control—an enactment firm and just to municipality and rural community alike. Most cities do not have the money to retain expert engineers, rate men, statisticians and other expensive equipment for the work. Divided control is always confusing and the recent state-wide extension of transmission lines heightens this rate-making confusion when several separate bodies pass upon the rates. Unquestionably state-wide regulation is conducive of more just results to people and utility alike, for in the majority of cases, local prejudices and local political upheavals—a condition to be absolutely divorced from regulating consideration—enter not in the slightest degree in adjustments of rates and appraisals. Indeed state-wide control has every argument in its favor, not the least among which are the examples of unified state control of all eastern regulating commissions.

In reviewing the accomplishments of the present California commission much credit is theirs for the successful and harmonious deliberations that have been brought about for the common good among public utility managers, lawyers and engineers. As an instance of this may be cited the recent call of the commission to discuss the question of "clearances." In this brief friendly discussion more was accomplished in the way of evolution toward uniformity in design in one afternoon than has been brought about in years of disconnected discussion among the utility engineers and managers.

In conclusion, it may be said that while we feel a slight departure has been made by the California commission in encouraging destructive competition in certain cases, yet in its completeness the wholesome effect of their wise and painstaking investigation and direction of California public utilities is most apparent. In consideration of the present high standing of California public utility securities and every indication of efficient and economic operation of the utility companies under commission regulation, we believe the neighboring State of Oregon would do well to emulate the essential features of California regulation in her forthcoming enactment.

PERSONALS.

R. D. Holabird and family spent the past week at their summer residence on the shores of Lake Tahoe.

W. Brewster Hall, Pacific Coast manager for Pass & Seymour, Inc., visited Lake Tahoe during the week.

C. W. McKillip, district manager for the Pacific Gas & Electric Company at Sacramento, is a recent San Francisco visitor.

P. H. Coolidge, general commercial superintendent of the Pacific Telephone & Telegraph Company, is visiting New York and Boston.

C. E. Groesbesk, one of the vice-presidents of the H. M. Byllesby & Company, is at San Francisco with Mrs. Groesbeck, preparing to take a long vacation.

S. L. Shuffleton, who has general charge of the Stone & Webster Construction Company's operations on the Pacific Coast, has returned to Fresno from Seattle.

W. G. Kittredge, chief engineer of the New York Central Railroad Company, one of the pioneer steam roads in adopting electric traction, is visiting the Yosemite Valley.

Hugh McPhee, district commercial superintendent of the Western Union Telegraph Company with headquarters at Los Angeles, is among the week's arrivals at San Francisco.

S. L. Berry has resigned as hydraulic engineer for the Joshua Hendy Iron Works and opened offices as consulting hydraulic and mechanical engineer in the Rialto Building, San Francisco.

Gaskell S. Jacobs, formerly with the appraisal department of J. G. White & Company, Inc., is now with the Northwestern Division of the Great Western Power Company at Napa, Cal.

H. R. Noack, president of Pierson, Roeding & Company, is accompanying **A. H. Babcock**, consulting electrical engineer for the Southern Pacific Company on an automobile trip through Oregon.

J. E. Fries, Pacific Coast electrical engineer with the Crocker-Wheeler Company at San Francisco, has been transferred to the grade of member in the American Institute of Electrical Engineers.

A. F. Bridge, formerly in the employ of the Great Western Power Company, has returned from an Alaskan trip to assume his duties as a John W. Mackay Jr. fellow at the University of California.

H. C. Stoddard, general superintendent of the California-Oregon Power Company, at Medford, Ore., has been transferred to the grade of member in the American Institute of Electrical Engineers.

H. V. Carter, president, and **W. L. Goodwin**, vice-president and general manager of the Pacific States Electric Company, are among those attending the jobbers' convention at Lake Tahoe this week.

J. S. Badger, general manager and chief engineer of the Brisbane Tramways Company of Brisbane, Australia, arrived at San Francisco during the week en route to the Eastern States on railroad business.

J. P. Edwards, consulting electrical and mechanical engineer, Northern Electric Railway, Chico, Cal., has been transferred to the grade of member in the American Institute of Electrical Engineers.

C. C. Hillis, general manager of the Electrical Appliance Company, who has been in the East several weeks, is expected to return to San Francisco early next week after spending a few days at Lake Tahoe.

H. J. Bosch, formerly assistant to J. P. Jollyman of the Pacific Gas & Electric Company, has joined the Panama-Pacific International Exposition Company as an assistant in the electrical department.

H. G. Dickson, superintendent of the erecting department of the Babcock & Wilcox Company, is a recent San Francisco visitor and attended the engineers' club dinner at the Palace Hotel last Tuesday noon.

I. L. Capps, formerly with the lamp department of the General Electric Company, has accepted a position with the Pacific States Electric Company and will have charge of the lamp sales for them in the San Francisco district.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company, is visiting Humboldt County with his brother, Paul Goldrick, an electrical supply man who recently arrived in California from Indianapolis.

C. F. Peirson, manager of the advertising department of the Southern California Edison Company, has returned to Los Angeles from a month's vacation, which included an automobile tour of eastern California and western Nevada.

R. F. Chevalier, consulting engineer, has returned from Los Angeles where he has been conducting tests upon the new oil burners of the Union Iron Works Company at the Long Beach plant of the Southern California Edison Company.

R. W. Sorensen, professor of electrical engineering at Throop Polytechnic Institute at Pasadena and delegate from Los Angeles to the national meeting of the American Institute of Electrical Engineers, has returned from a two months' Eastern trip.

H. M. Hepburn, general manager of the Hawaiian Electric Company, Ld., which holds the agency for the Westinghouse Electric & Manufacturing Company in the Islands, besides furnishing electric power, lighting and ice at Honolulu, is at San Francisco.

Emil Liersch, engineer for the Ferrum Pipe Company of Germany, represented exclusively in the United States by the Pelton Water Wheel Company, is at San Francisco on business connected with a lap-welded pipe contract in which the Pelton Company is interested.

W. A. Hillebrand, professor of electrical engineering at the Oregon Agricultural College, and **Robert Sibley**, professor of mechanical engineering at the University of California, and editor of this journal, have been appointed western members of the educational committee of the A. I. E. E. by President Mershon.

John R. Freeman, the engineering expert who made a report on the Hetch-Hetchy valley water supply, recently inspected the work in progress at the site of the Great Western Power Company's dam at Big Meadows. The rock has been uncovered for some distance and a large construction force is now placing concrete at the base of the new dam.

A. W. Bullard, general manager of the Great Western Power Company, states that a contract has been awarded to the I. P. Morris Company for two additional water wheels for the extension of the Las Plumas power station at Big Bend. The two turbine wheels of the Francis type are rated at 18,000 h.p. each. They will have vertical shafts and will be similar to the other wheels now in use.

R. G. Hanford, who is interested with F. M. Smith and W. S. Tevis in the United Properties Company, the holding corporation for several light and power plants in San Francisco and local electric traction lines in Alameda County, has returned to California after a four months' trip abroad. While in Great Britain he conferred with bankers who have helped to finance his large enterprises. **George H. Taylor**, a Chicago financier, who was one of the underwriters for the Key Route transportation system, is also at San Francisco.

JOBBERS AT LAKE TAHOE.

The Pacific Coast electrical jobbers are enjoying an outing at Lake Tahoe this week. Those in the party include H. V. Carter, T. E. Bibbins, C. B. Hall, J. A. Vandegrift, Albert H. Elliott, W. L. Goodwin, C. H. Carter, Ross Hartley, C. R. Dederick, W. Brewster Hall, H. E. Sanderson, C. E. Wiggin, S. B. Gregory, Duncan Reynolds, Garnett Young, G. I. Kinney, Frank Fowden, A. E. Barlow, F. H. Murray, W. I. Berry, R. D. Holabird, C. C. Hillis.

THE ENERGY CLUB.

The Energy Club is the outgrowth of a series of lunches which have been held at the Palace Hotel, San Francisco, on Wednesday, by a number of central station men and electrical manufacturers. On August 22 a constitution was adopted and an executive committee elected. Membership is open to anyone interested in power apparatus. No dues will be collected. The executive committee consists of R. L. Van der Naillen, T. E. Bibbins, A. W. Bullard, W. W. Briggs and S. V. Walton, Mr. Bibbins being chairman, and Mr. Walton secretary.

JOVIAN CLUB OF SAN FRANCISCO.

The San Francisco members of the Rejuvenated Sons of Jove perfected the organization of a lunch club at a meeting held at Tait's cafe on August 20. Weekly meetings are to be held at lunch on Tuesday. The committee on the constitution and by-laws, consisting of C. F. Butte, R. M. Alvord, W. W. Hanscom and A. H. Halloran, submitted its report, which was accepted, and suggested the names for the governing board, who were elected to hold office until a new election takes place. The members of the board are R. M. Alvord, Geo. C. Holberton, W. W. Hanscom, W. S. Hanbridge, and W. I. Otis. It is planned to hold the next rejuvenation on September 10th.

CALIFORNIA ELECTRICAL CONTRACTORS' ASSOCIATION NOTES.

The Electrical Contractors and Dealers' Association of San Francisco held a meeting last Tuesday at the Mayor's office which was attended also by Mayor James Rolph Jr. and the Architectural Commissioner. As a result it has been decided that, in future, on all municipal building jobs the total cost of which is $50,000 and over, the same shall be confined to about twelve separate contracts. This is a victory for the specialty contractors.

The John G. Sutton Company has been awarded a contract for a five-story apartment house at Van Ness avenue and Bush street for James Sweeney. The electrical work amounts to about $3400. The same contractors have also taken a $1900 contract to wire a new building that is to be erected on Jessie street between Annie and Third for the Sharon Estate.

The Butte Engineering & Electric Company has been awarded the electric work on an apartment house on the corner of Post and Fillmore streets for $4000.

The Central Electric Company has secured a $3000 electric contract on a building for Ray Levin at Sacramento.

NEW CATALOGUES.

Butte Engineering & Electric Company, San Francisco, have issued a catalogue of special electrical apparatus which they manufacture, including electric heaters, regulators, indicators and switchboards.

Bulletin No. 1091 from The Ideal Electric & Manufacturing Company, constitutes one of the most valuable and complete treatises on Elevator Motors which has been published. It includes a number of curves and tables on hoisting requirements.

The engineering department of the National Electric Lamp Association has just issued bulletin 2A, which set forth in an attractive manner the methods employed by the association in securing their engineering data. Bulletin 2B, just issued, covers the description and performance of gem metallized filament lamps. Bulletin 3B is devoted to the description and performance of gem metallized filament lamps, with data on the cost of producing light with them.

Switchboard Meters is the title of an attractive publication with an art cover just issued by the Westinghouse Electric & Manufacturing Company which very fully describes the complete line of switchboard meters recently brought out by this company. In addition to describing and illustrating these meters, the circular contains reprints of papers by Mr. Paul McGahan on (1) Modern Tendencies in the Design of Switchboard Indicating Meters, and (2) Theory and Performance of Induction Instruments.

BOOK REVIEW.

Walker's Manual of California Securities and Directory of Directors, 1912 edition. Compiled by H. D. Walker. For sale by Technical Book Shop, San Francisco. Price $3.00.

The 1912 edition of this valuable reference work gives the facts about a large number of companies not mentioned in the 1911 edition. One of the most valuable of several new features incorporated are maps of the properties of several of the electric power companies.

Electrical Blue Book—1912 Edition. Size 9x11½ inches; 206 pages; replete with illustrations; compiled and published by the Electrical Review Publishing Company of Chicago and for sale by the Technical Book Shop, 106 Rialto Building, San Francisco.

This book contains a comprehensive exhibit of officially approved electrical supplies, to which is added an illustrated list of other representative lines of electrical material and the National Electrical Code, illustrated and explained. Much confusion and poor installation constantly exists due to imperfect knowledge as to just what comprises the approved form of electrical work. Here is a book replete with the desired information. No contractor or wireman can afford to be without this latest edition.

Primer of Scientific Management. By Frank B. Gilbreth, with an introduction by Louis D. Brandeis. Size 5x7½ in.; 108 pages; no illustrations; cloth binding. Published by D. Van Nostrand Company of New York and for sale by the Technical Book Shop, Rialto Bldg., San Francisco. Price $1.00.

The author, Frank B. Gilbreth, is well known to those interested in the advancement of scientific management in the industries, as evidenced by the wide circulation enjoyed in his works on motion study, concrete system, bricklaying system and fuel system. The book before us is treated in the question and answer form. These questions are chosen from hundreds that have come to the author from all parts of the world, with requests for further information on the subject of the elimination of unnecessary waste in human effort. The growth of scientific management is a nation-wide movement looking toward industrial betterment for the manufacturer and the laborer—one in which minimum human effort is put forth for maximum return to mankind. The book adds another chapter in this growth and all interested will find these miscellaneous questions and answers of the same profit as the discussion of a technical paper always bears to the main issues presented. The questions are arranged in logical order and are presented under five main headings—definitions of terms of scientific management, laws or principles, application of the laws, the effect on the work, and the relation of scientific management to other lines of activity.

A SATISFACTORY LICENSE LAW FOR ELECTRICAL CONTRACTORS.

The only state license law for electrical contractors which has been upheld by the courts is that of Tennessee. Believing that its provisions will be valuable in suggesting those for other states it is printed in full as follows:

An Act to regulate, in cities of more than 75,000 inhabitants, according to the Federal Census of 1900, or any subsequent census, the licensing of persons, firms and corporations conducting or managing a business for installing any wires or electrical apparatus to convey electrical current for light, heat or power, and to provide for a Board of Electrical Examiners and Supervisors for said purpose and to prevent the doing of such electrical work by persons, firms or corporations other than those licensed in accordance with the provisions of this Act, and to provide a penalty for the violation thereof.

Section 1. Be it enacted by the General Assembly of the State of Tennessee, That within thirty days after the passage of this Act the Governor shall appoint in each city in the State of Tennessee, of more than 75,000 inhabitants, according to the Federal Census of 1900, or any subsequent census, a Board which shall be known as the Board of Electrical Examiners and Supervisors, consisting of three persons, for the purpose of examining into the qualifications and capabilities of Master Electricians, as defined by Section 5 in this Act.

The members of said Boards so appointed shall be competent practical electricians, one of whom shall be nominated by the oldest existing association of electrical contractors in the city of his appointment, and if no such association exists, then he shall be a contracting electrician who has been publicly engaged in such business in the city of his appointment for at least three years prior to the date of his appointment; the second to be nominated by the Chief of the Fire Department, and the third by the Local Association of Fire Underwriters, if any such association exist in the town where the appointment is to be made; and if no such association is in existence, then the third member to be appointed upon the nomination of the two members hereinbebefore designated. The term of each member shall be one year from date of appointment. Should any vacancy occur from any cause during the term of any Board as herein provided, the Governor shall appoint some one from nominations made as above provided, to fill such vacancy, and this in such manner that the various Boards shall continue to be constituted as herein provided.

The Governor shall have full power to remove any member of the Board for incompetency or improper conduct, upon satisfactory evidence thereof being presented to him.

Section 2. Be it further enacted, That the members of said Board shall respectively take and subscribe to oath required of State officers. They shall have the power to elect, out of their number a president, a secretary and a treasurer; to adopt such rules and by-laws for the transaction of the business of the Board as they may deem expedient.

Section 3. Be it further enacted, That each member of said Board shall receive a compensation of Five ($5.00) Dollars per day for actual service in attending meetings of the Board, which compensation shall be paid out of the moneys in the hands of the treasurer of said Board; Provided that the secretary of said Board may receive such additional compensation as the Board may deem just and reasonable, and for which the by-laws of the said Board may provide. In no event, however, shall the compensation of the members of the said Board or their secretaries be paid out of the funds in the State Treasury or become a charge against the State; but the compensation of all members of said Board, including the secretary, shall be paid out of fees collected by said Board, under the provisions of this Act.

Section 4. Be it further enacted, That said Boards shall meet at least once each month in their respective domiciles, and shall hold special meetings as frequently as the proper and efficient discharge of their business shall require, and each Board shall adopt rules and regulations for the examination of master electricians as herein defined, and when so adopted, such rules and regulations shall have the same force and effect as if herein contained; and the rules of said Board shall also provide for the giving of timely notice of such meetings to all those who shall have made application for a license, as herein provided; and said Board shall give in writing, to the respective cities, or to any officer designated by the Legislative Council thereof, a detailed statement of all licenses issued, renewed or revoked at any meeting of said Board. A majority of its members shall organize each of said Boards and constitute a quorum for the transaction of its business.

Section 5. Be it further enacted, That the term "Master Electrician" as used in this Act, shall be so defined as to include any and all persons, firms and corporations engaged in the business of, or holding themselves out to the public as engaged in, the business of installing, erecting or repairing, or contracting to install, erect or repair electric wires or conductors, to be used for the transmission of electric current for light, heat or power purposes, or moldings, ducts, race-ways or conduits, together with fittings for same, for the reception or protection of such wires or conductors, or to electrically connect electric wires or conductors together, or to any electrical machinery, apparatus, device or fixtures to be used for electric light, heat or power purposes.

A license of "Master Electrician" issued or granted under and in accordance with the provisions of this Act, shall entitle any such person, firm or corporation so licensed to engage in the business of installing, erecting or repairing, and of contracting to install, erect and repair, any electric wires or conductors to be used for the transmission of electric current for electric lights heat or power purposes, and any moldings, ducts, race-ways and conduits, together with fitings for same, to be used for the reception and protection of such wires and conductors, and to electrically connect such electric wires or conductors together and to any apparatus, devices, fittings or fixtures to be used for electric light, heat or power purposes.

Section 6. Be it further enacted, That before any person, firm or corporation shall hereafter engage in the business of a "Master Electrician," as defined in Section 5 of this Act, and before any person, firm or corporation now so engaged in said business, or any branch or class thereof, shall continue in said business of "Master Electrician," such person, firm or corporation shall apply to said Board for a license to practice as "Master Electrician," and the applicant, if a person, or if a corporation, one of the officers or a representative and agent thereof, to be designated by said corporation, or if a firm, one of the members thereof, shall present himself before the said Board at a time and place fixed by the said Board. If the Board shall find, upon due examination, that the applicant presenting himself is of good moral character, has a satisfactory knowledge of electricity and the natural laws appertaining to and governing the same, and of the use and function of electric wires, appliances and devices for electric light, heat and power purposes, and is possessed of skill and knowledge in all matters pertaining to the business of a "Master Electrician," as defined in Section 5 of this Act, the said Board, upon payment of the fee, and upon giving bond, hereinafter provided for, shall issue to the said person, firm or corporation a license as "Master Electrician" to practice said business for a term of one (1) year and shall register such person firm or corporation as duly licensed "Master Electrician."

Provided, That no license shall be granted to any person, who has not taken and subscribed an oath that he, or in

case of a corporation, one of the principal officers of the representative and agent thereof, and, in case of a firm, one of the members thereof, has had at least three (3) years' actual experience as a Master Electrician, within the terms of this Act, or as an electrical workman, in such class or classes of electrical business or work as in the opinion of the Board, shall have properly fitted the applicant for a license as Master Electrician.

Provided further, That each applicant, at the time of filing his, their or its application, shall pay to the secretary of said State Board of Electrical Examiners the sum of Twenty-five ($25) Dollars and provided, moreover, that every person, firm or corporation, before receiving a license, shall make, execute and deliver a bond to the State of Tennessee in the full sum of Twenty-five Hundred ($2500.00) Dollars, with sufficient surety or sureties, to be approved and filed with the said Boards, the bond to save harmless the owner or real party in interest in the property for which any such material furnished, or service performed, against loss or damage which shall arise by reason of the work done or material furnished being in violation of and below the standard of the current edition of the National Electric Code; but action can be maintained thereon in the name of such owner or real party in interest only, if commenced within one (1) year from and after the date of the installation of the materials furnished or performance of such work or service.

When however, the material furnished or work done, or service performed, shall have been inspected, and a written or printed certificate of approval issued by a legally authorized city electrical inspector, then the said Master Electtrician shall be considered as having fulfilled the requirements of this Act, and his responsibility shall cease under the above bond for material furnished and work or service performed.

Section 7. Be it further enacted, That all persons, firms or corporations that at the time of the enactment of this Act are engaged in the business which shall be hereafter known as the business of a Master Electrician as described in Section 5 of this Act, shall, within sixty days after the passage of this Act, comply with all the provisions of Section Six (6) of this Act, or such persons, firms or corporations, shall, within 60 days after the passage of this Act, cease to do the work which shall be hereafter known as that of a "Master Electrician" as described in Section 5; otherwise, he, they or it, shall be guilty of a misdemeanor and, on conviction, suffer the fines and penalties set forth in Section Fourteen of this Act.

Section 8. Be it further enacted, That each and every license issued under the provisions of this Act shall be signed by the president and secretary of the Board and attested with its seal and said license so signed and attested, for a period of one year, shall be evidence in any court in the state of the business for which the license is issued. All licenses and renewals of same shall expire on the first day of January, of each year.

Section 9. Be it further enacted, That no person, firm or corporation, granted a license under the provisions of this Act, shall continue in the business of installing or repairing electrical wires conductors or apparatus for electric lights, heat or power purposes after the expiration of the said license, unless the said license or extension of same shall have been renewed, as hereinafter provided.

Upon payment of a fee of Ten ($10.00) Dollars, any person, firm or corporation, granted a license under the provisions of this Act (unless the said license shall have been revoked as hereinafter enacted) shall be granted a renewal of said license without examination of the applicant if application therefore is made either in person or in writing to the said Board by the holder of such license within the three months preceding the expiration of such license upon payment of a fee of Ten ($10.00) Dollars and the said renewal of said license shall be made for a period of one (1) year, and shall be signed and attested, as required for such original license, and any such renewal of such license so signed and attested shall have the same weight as evidence in any court in this state as is hereinbefore accorded said original license.

Provided, also, That further one-year renewals shall be granted in like manner, upon expiration of any renewal of license upon making application and paying a like fee within three months preceding the expiration of such renewal, in the same manner as provided for the first renewal.

Section 10. Be it further enacted, That after a full hearing of all parties in interest, said Board shall have power to revoke, for proper cause, any license, or renewal of same, granted by the same Board.

Section 11. Be it further enacted, That each and every license and renewal of same shall be in force and effect only so long as an approved bond, filed with the said Board, in accordance with the provisions of Section 6 of this Act, shall remain in force, and every such license, or renewal of same, shall become void by the termination of said bond, regardless of the regular date of expiration of the said certificate, license or renewal.

Section 12. Be it further enacted. That any and all persons, or corporations, granted a license, or renewal thereof, in accordance with the provisions of this Act, shall display the same in a conspicuous place, in the office or place of business of the person, firm or corporation to which it was issued.

Section 13. Be it further enacted, That nothing in this Act shall be so construed as to prevent any person from doing or performing any of the kinds of work enumerated in Section 5 of this Act, when such work is performed under the direction and supervision of a duly licensed Master Electrician; but no work other than minor electric repairs, for the maintenance of established plants, shall be performed, excepting under such direction and supervision of a duly licensed Master Electrician, and the said licensed Master Electrician shall be responsible for any work, and all work, so done under his direction and supervision. This shall be construed as exempting lighting companies and electric railway companies from the provisions of this Act insofar as the maintenance and installation of their equipment, pole-lines, services and meters are concerned.

Section 14. Be it further enacted, That any person, firm or corporation, who shall practice or engage, or continue in the work of a Master Electrician, as defined in Section 5 of this Act, and any person not licensed as a Master Electrician, who shall do or perform any such work, except under the direction of a Master Electrician, or who shall violate any of the provisions of this Act, shall be guilty of a misdemeanor, and, upon conviction thereof, shall be sentenced to pay a fine of not less than Ten ($10.00) Dollars, nor more than One Hundred ($100.00) Dollars, or to an imprisonment not exceeding thirty (30) days, or both, in the discretion of the Court.

Section 15. Be it further enacted, That no license, or renewal of same, granted or issued under the provisions of this Act, shall be assigned or transferrable, and every such license or renewal of same, shall specify the name of the person, firm or corporation to whom it is issued, and in case of firm, the member of said firm, and in case of a corporation, the principal officer or the designated representative of the said corporation through whom the application for the said license was made.

Section 16. Be it further enacted, That all fees collected under the provisions of this Act, shall be for the use of said Board, to defray its necessary expenses.

Section 17. Be it further enacted, That it shall be the duty of each of said Boards, before the first Monday of January of each and every year, to make a report in writing to the Governor of the state, containing a detailed statement of the nature of the receipts and the manner of expen-

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INDUSTRIAL

NEW CUTLER-HAMMER FEED-THROUGH OR CORD SWITCH.

The use of a feed-through or cord switch at the table provides convenient means for controlling the current to heating devices. It eliminates the necessity for getting up to operate the fixture socket or for pulling the base plug. Pulling the cord plug of the device often results in spilling a cup of coffee or other accident so embarrassing at the table. The new brass shell cord switch made by The Cutler-Hammer Manufacturing Company of Milwaukee, because of its small dimensions and polished nickel finish is particularly suited for use with heating devices at the table. Convenient operation is provided by simply pushing the button of the switch placed near the device. It is not necessary to hold the switch with one hand and operate it with the other. When used with electric irons it saves the wear on the socket and allows easy and frequent opening and closing of the circuit. When installed the cord passes through the switch, bushings being provided in both caps.

New Cutler-Hammer Feed-Through or Cord Switch.

The new insulating material developed in the Ceramic Laboratory of The Cutler-Hammer Manufacturing Company, is used as the body of the switch. This material is tough, withstands hard usage and holds in permanent alignment the small compact operating mechanism, which is similar to that used in the "Acorn" pendent switch recently marketed. This new switch is approved by the Underwriters' Laboratories and bears their label. The rating is 3 amperes, 250 volts, 5 amperes, 125 volts. The illustration is full size.

TRADE NOTES.

F. A. Richards, manager of the car department of Pierson, Roeding & Co., has returned to San Francisco from Vancouver, B. C., where he closed a good order for city cars for the British Columbia Electric Railway Company, Ltd. The contract calls for 35 P.-A.-Y.-E. Brill semi-convertible cars for single end operation. The car bodies are to be 43 ft. long. The motors and air brakes will be let separately. Richards says business conditions in British Columbia are quite encouraging.

The Duncan Electric Manufacturing Company is announcing, through its San Francisco representative, Mr. G. A. Wilbur, that it is now prepared to furnish "Duncan" meters, both a.c. and d.c., equipped with its new cyclometer dials. These meters register direct in numbered kilowatt hours, and can therefore be easily read by consumers. This will put an end to many disputes and the company thinks it is only a question of time when this form of meter will be universally used.

The General Electric Company has been awarded a contract for the generators and a lot of auxiliary apparatus for one of the Big Creek power stations of the Pacific Light & Power Company. The specifications call for: Two 17,500 kw., 375 r.p.m., 6600 v., 3 phase, 60 cycle water-wheel type generators. Also, one induction motor exciter set and one water-wheel driven exciter. Switchboards for this power station and for the Big Creek substation are also included in the contract. Also, one 15,000 kva., 375 r.p.m, 6600 volt, 50 cycle, 3 phase, synchronous G. E. condenser, will be installed at the Big Creek substation, about 135 miles from the power station, for voltage regulation on the 275-mile transmission line to Los Angeles. This machine is so designed that it can be used in the future, if desired, to drive a 3000 kw. direct current generator. Six water cooled, 50 cycle, 4500 kva., 150,000 v./18,000 v. transformers and 3 W.C. 5000 kva., 15,000 v./6600 v. transformers complete the list of apparatus ordered.

The Great Western Power Company's new office building, at 233 Post street, has been equipped with two large vertical electric signs that attract much attention. The Federal Sign System was adopted and flashes of lighting appear to dart along the words "Electric Service." One of the signs bears the initials of the Great Western Power and the other those of the City Electric Company. The appliance department now has a complete display of its electrical goods in the large room on the ground floor.

An attractive exhibit will be made by the Pacific States Electric Company at the Second Annual Melon Carnival, to be held in Turlock Cal. on September 21st to 24th, inclusive. Washing machines, vacuum cleaners, ozonators, cooking and heating devices in operation should prove a great drawing card for the electrical part of the exposition and will doubtless keep the several men in attendance busy explaining the merits of the various devices, including the "Easy" washing machine, which cleans clothes by the vacuum process. The booth will be in charge of M. L. Scoby and B. Badnan.

An interesting hydroelectric plant is being built by the Sierras Construction Company at Laws, Inyo County, Cal. for the Nevada California Power Company, now known as the Southern Sierras Power Company. This plant consists of three 3600 h.p. water wheel equipments driving engine type generators and is to supply the San Gabriel Valley and Los Angeles territory over the longest single transmission line in the world, this being 234 miles long. The water wheel equipment involves several novel features, including a complete Henry automatic water economy apparatus which provides maximum water economy equivalent to the best turbine practice with an absolute absense of water ram or pressure fluctuation in the pipe line and at the same time effects most accurate speed regulation. The use of apparatus of this nature is being demanded by all of the best power installations in order to increase the power salable from a given water quantity available. Contracts for the hydraulic apparatus have been let to George J. Henry Jr., 733-9 Rialto Building, San Francisco, Cal.

(Continued from page 167)

diture, and any balance of money remaining at the end of the year, after payment of expenses, including per diem of members of said Board, and other necessary expenses incurred by them in the discharge of their duties, shall be deposited in the State Treasury.

Section 18. Be it further enacted, That all laws, and parts of laws, contrary to, or in conflict with, the provisions of this Act, be and the same are hereby repealed.

Section 19. Be it further enacted, That this Act shall take effect from and after its passage, the public welfare requiring it.

NEWS NOTES

ILLUMINATION.

BAKER, ORE.—This place is asking bids for city lighting.

NAMPA, IDAHO.—C. M. Talmadge, of New York, who secured a power site on the Canyon canal, will start work at once.

LOS ANGELES, CAL.—As a part of a general plan to establish a "Great White Way" the whole length of San Fernando Valley, citizens of Van Nuys August 10 voted to organize a lighting district.

HOUSTON, TEX.—Work has started on a new gas reservoir for Houston. A tank costing $250,000 and capable of holding 3,000,000 cu. ft. of gas will be completed by March 15, 1913; 13,000 ft. of concrete will be used for the foundation.

PHOENIX, ARIZ.—The Pacific Gas & Electric Company of this city has been purchased by a group of men who thus became heavily interested in local affairs. F. S. Viele and R. S. Masson of Los Angeles are in the city to take possession.

BERKELEY, CAL.—A voluntary reduction of from 7c to 5c a kilowatt hour in the cost of electric current for commercial purposes has been announced to the Berkeley City Council by the Pacific Gas & Electric Company. For power purposes the rate is reduced from 5c to 3c.

KAMLOOPS, B. C.—A complete report of the hydroelectric plant on the Barrier River and a steam auxiliary equipment for the city, which Dutcher, Maxwell & Company have had in preparation for several months, has been submitted to the Council. It is estimated that the plant will cost $237,600 and will generate 2000 h.p.

LOS ANGELES, CAL.—A meeting of the stockholders of the Central California Gas Company will be held at 10 o'clock a. m., September 25, at the office of said company, in the International Bank Building, for the purpose of considering and acting on the matter of creating a bonded indebtedness of said company in the sum of $500,000.

FRESNO, CAL.—An expenditure of $65,000 in installing in Fresno a system of gas mains is announced by Manager W. M. Henderson of the Pacific Gas & Electric Company. A force of 150 men is already in Fresno ready to begin work. Under the new system of gas mains Fresno will have pipes as large as 16 inches, while the largest pipe hitherto has been 12 inches, and that only extends for a half dozen blocks. The installation of hig mains will do away to some extent with the high-pressure pipes, which are subject to a high percentage of leakage.

WASHOUGAL, WASH.—The Northwestern Light & Power Company has a force of men working at this place resurveying the route laid out a year ago and setting the stakes for poles for the transmission of power. It has unloaded three or four cars of a variety of line equipment. All the right of way between here and the power dam has practically been secured and work is being pushed along the line in this region as fast as possible. The surveyors and engineers have opened an office in this city and work out from here.

LOS ANGELES, CAL.—At a meeting of officials of the Midway Natural Gas Company and the gas distributing companies of this city important steps were taken in the negotiations for the delivery to all city consumers of natural gas which is soon to be brought here from the Midway field in Kern County by the Midway Gas Company. The gas is of the highest quality and the supply is practically unlimited. It will be delivered here by the Midway company through two great pipe lines, the laying of which is costing $4,000,000. These lines will have a capacity of 75,000,000 cubic feet daily. The present consumption of the city and vicinity is about 20,000,000 cubic feet daily. The Midway Gas Company is the operating and constructing company. Its officers are John Martin, San Francisco, president; W. G. Kerckhoff and A. C. Balch of this city, and Cyrus Pierce of San Francisco, directors. The laying of the first pipe line, work on which is now nearing completion, is a triumph of engineering efficiency. Work was begun last April. Three crews are now closing gaps in the middle of the line at the rate of a mile a day. The man in charge of this big engineering feat is William E. Barrett. H. B. Dougherty is superintendent of construction. The first line is of 12-inch pipe and will cost about $1,500,000. The second line will be a 16-inch pipe and will cost $2,500,000. These lines will have a delivering capacity of 75,000,000 cubic feet a day. If the plans for complete abandonment of the use of artificial gas are consummated elaborate provision will be made to safeguard all gas consumers against any possible chance of an interruption of supply. Ten patrol stations will be located along the pipe line and the line will be carefully and continually watched night and day. According to officers of the Midway company this city is to have natural gas not later than next April. Upon the negotiations now in progress depends whether or not the manufacture of artificial gas is to cease entirely.

TRANSPORTATION.

CORVALLIS, ORE.—Active work of clearing the right of way and grading for the Oregon Electric is going on across the river from here.

VANCOUVER, WASH.—It is announced that the Washington-Oregon Corporation will build an electric line from Sifton to Camas if a $20,000 bonus is raised.

PORTLAND, ORE.—Six thousand people have petitioned for an extension to the Mount Tabor car line, and the petitioners agree to pay $10,000 toward the construction of the line.

PORTLAND, ORE.—Fred A. Jacobs Company has asked for a permit to construct the Errol Heights Railway, to be a short line from Errol Heights to connect with the city street car lines.

EUGENE, ORE.—A contract for building the Monroe-Eugene line of the Portland, Eugene & Eastern Railway, has been let to Flagg & Standiter, the contract covering about 25 miles of roadway.

SALEM, ORE.—A 35-year franchise has been granted to the Portland, Eugene & Eastern Electric Railway. This means the expenditure of $1,000,000 by that company within the city limits during the year.

LOS ANGELES, CAL.—The tramway system of the city of San Luis Potosi has been sold by its Mexican owners to an English company, consisting of Messrs. Hooghwihkel, Brown and partners of London. The new owners will electrify the line.

ELLENSBURG, WASH.—French capitalists who are promoting the electric road between Cle Elum and Roslyn are considering a tunnel through the Cascade mountains to tap the Sound country, it is reported. The French concern owns a power site at Salmon La Sac.

WENDELL, IDAHO.—J. W. Crowley of the Crowley-Salisbury Construction Company of Davenport, Ia., and J. Stewart Clark of Buffalo, N. Y., are promoting an electric line between this place and Hagerman, the road to be 15 miles long. It is expected that construction work will start this fall.

CHEHALIS, WASH.—Work on the Chehalis-Toledo electric road has been resumed and will now be rushed to completion. The graders are at work at a point six miles out of Chehalis. This interurban line will connect one of the thickest settled communities in Southwest Washington with a railroad.

OLYMPIA, WASH.—A copy of a resolution has been filed with the secretary of state which was adopted at Philadelphia at a meeting of the Washington & Oregon Corporation, authorizing and directing the extension of the Chehalis-Centralia Interurban line from the Centralia terminus in Lewis county by way of Tenino to Tumwater.

BOISE, IDAHO.—The first step of the consolidated company which has taken over the Boise Valley, The Boise Railway and the Boise & Interurban electric lines, has been to look over the field with a view of making extensive improvements. One of these improvements will be constructing a loop to take in the north end of the city.

PHOENIX, ARIZ.—M. H. Sherman of Los Angeles, owner of the Phoenix Street Railway Company, will shortly begin the erection of a four-story building at the corner of Washington street and Second avenue. The structure will have connection with the reorganization of the street railway system and will be used for a central transfer station and offices.

SEATTLE, WASH.—It is reported that Wm. D. Hall, vice-president of the Grote-Rankin Company, J. S. Wheeler, of Wheeler & Heath, New York block, and S. L. Cravens, president and manager of the Pacific Lumber & Timber Company, will build an interurban line from this city to Olympia via Tacoma. The company will be known as the Seattle-Tacoma-Olympia Railway Company and is incorporated for $1,500,000.

SAN FRANCISCO, CAL.—The Board of Public Works at the last meeting considered W. D. Donald for inspector of car construction for the Geary street road, the duties to consist of making examination of the cars manufactured for the municipal line. He was recommended by City Engineer Manson and Commissioner Fraser. Minor changes in the construction plans for the new cars were approved. The board received eight bids for the underground conduit from Kearny street to Presidio avenue, which is to contain the feed wires. The lowest offer was submitted by Gruve & McCafferty, $26,901, and the highest, $41,409.50, by the Contra Costa Construction Company.

BURLINGAME, CAL.—Ansel M. Easton, capitalist and founder of the town of Easton, is en route to Europe, where he will confer with Ambassador and Mrs. Whitelaw Reid on the financing of a system of street railways in Burlingame. He plans to return to the United States next month, arrange for a shipment of rails from Philadelphia, place an order for car equipment and begin construction of the local lines early in the spring. Easton holds a franchise for a street railroad through the town of Easton, in the northern district of Burlingame, and if present plans are carried through, an attempt will be made to secure other franchises in the central and western districts of the city.

PUYALLUP, WASH.—At a public meeting in Sumner, landowners between Sumner and Orting voted to file suit against the Stone & Webster interests for the recovery of seven miles of right-of-way granted nine years ago for the construction, as they allege, of a street car line between the two towns. Judge M. J. Gordon of Tacoma has been retained as counsel for the landowners and will file suit in the name of F. A. Stanblow. It is alleged by the valley landowners that they were induced to part with their land for a small consideration in money and the further consideration that an electric car service would be installed, and, further that it was the real intention of the company to use the right-of-way solely for carrying electric power from Electron to Seattle and Tacoma, as is now done.

RICHMOND, CAL.—The Southern Pacific Company has commenced the work of extending its electric system into Richmond. A work train and 150 men started grading at the junction of Twenty-third street and the Cutting boulevard. The B. W. Perrin Company has the contract for the work, which will cost $1,035,000, and will be completed in ten months. The extension, including the loop line in Richmond, will be nine miles long. The new line will connect with the Ninth street line at its terminal in Albany. The line will run from the Southern Pacific station in Pullman at the base of El Cerrito Hill, westward on Cutting boulevard to Washington avenue in Point Richmond. The proposed loop line, for which the company is now seeking a franchise, will run from the corner of Washington avenue and Cutting boulevard through West Richmond and Wall's second addition to Richmond back to the main line tracks of the Southern Pacific at Albany. The streets in the addition in which it is proposed to extend the line have not yet been named. The Richmond Council, at its meeting Monday, authorized the widening of Cutting boulevard to a width of 110 feet for the entire distance of five miles from Pullman station to Point Richmond.

TELEPHONE AND TELEGRAPH.

GLENDORA, CAL.—The Board of Trustees will receive bids up to September 3 for a franchise granting the right to carry on a general telephone and telegraph business in this city.

RIALTO, CAL.—The City Council will receive bids up to October 1 for the right to erect poles, wires, conduits, and cables for the transmission of electricity for telephoning and telegraph purposes.

SPOKANE, WASH.—A new telephone exchange costing $9000 will be installed at St. Maries, Idaho, by the Interstate Telephone Company, Ltd., which will have 1000 telephones placed at its disposal after the completion of the work.

PORTLAND, ORE.—Attorneys for the Home Telephone & Telegraph Company were unsuccessful in their efforts before Circuit Judge McGinn recently to secure the dissolution of the temporary injunction granted last week by Judge Gantenbein restraining the ousting of the Bell telephones from the Multnomah Hotel in favor of the automatic or Home telephones. The judge held that the question was one which should be tried out on its merits.

OLYMPIA, WASH.—Today the public service commission entered an order directing that subscribers of the Olympia farmers' line be allowed telephone connections with the Olympia Telephone Company or Bell system for $5 a year, this being a cut from $7.20, as fixed by the company. Formerly the subscribers of the rural lines in Olympia were connected with Olympia at a rate of $3.60 a year. The Bell company raised the rate to $7.20 and a complaint was filed. The Pacific Telephone Company is expected to fight the order. If no litigation is started it will perhaps cause a readjustment of rural telephone rates in all sections of the State.

LOS ANGELES, CAL.—The American Telegraph Company will have to obtain a franchise and pay 2 per cent of its gross receipts each year for the privilege of doing business in Los Angeles. This is the decision of the board of public utilities, which has served notice on the company that the permit under which the company has been operating in the past and which cost the company nothing, will run out in a few weeks and a new franchise will be required, including all the requirements now enforced on all corporation franchises. The new franchise will compel the company to remove its wires from poles, and to place them in conduits, and also will have a clause enabling the city to compel the company to place its wires in a general city conduit as soon as that innovation is installed.

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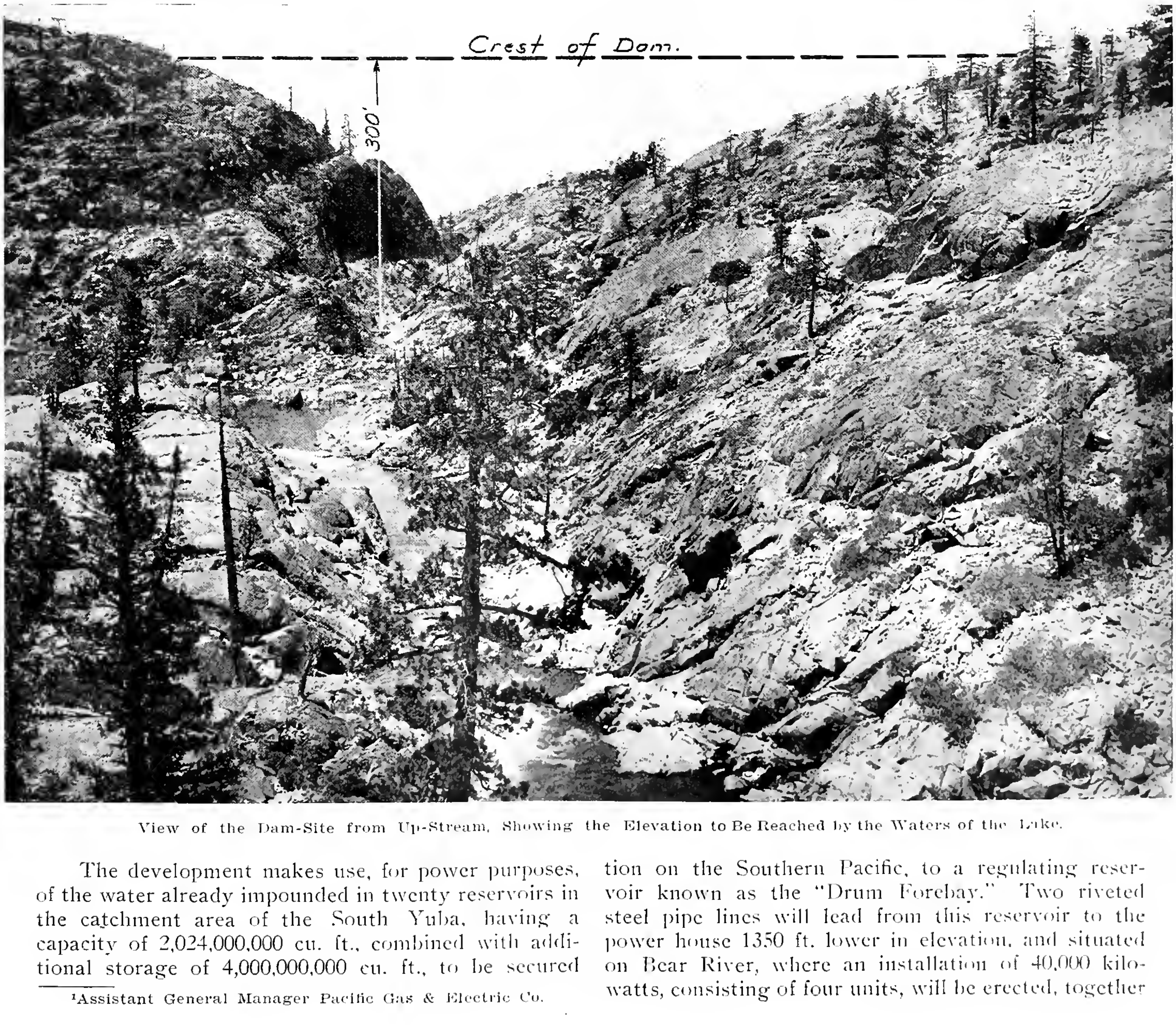
BEAR VALLEY HYDROELECTRIC DEVELOPMENT

BY JAMES H. WISE.[1]

The hydroelectric project on the south fork of the Yuba and Bear Rivers has been in contemplation for some time, but active work was not begun until permission was received from the Railroad Commission on July 3, 1912, by the Pacific Gas & Electric Co. at Lake Spaulding. The water thus stored is to be diverted, together with the natural run-off, to the Bear River water shed, conducting it in tunnels and canals along the south side of the Bear River Canyon to a point about three miles northeast of Towle Sta-



View of the Dam-Site from Up-Stream, Showing the Elevation to Be Reached by the Waters of the Lake.

tion on the Southern Pacific, to a regulating reservoir known as the "Drum Forebay." Two riveted steel pipe lines will lead from this reservoir to the power house 1350 ft. lower in elevation, and situated on Bear River, where an installation of 40,000 kilowatts, consisting of four units, will be erected, together

The development makes use, for power purposes, of the water already impounded in twenty reservoirs in the catchment area of the South Yuba, having a capacity of 2,024,000,000 cu. ft., combined with additional storage of 4,000,000,000 cu. ft., to be secured

[1]Assistant General Manager Pacific Gas & Electric Co.

with the necessary transformers, exciters, governors, and other adequate equipment to make the entire installation complete. Electric power from this plant will be transmitted at 115,000 volts on a double circuit steel tower line, extending in a southwesterly direction via Nicolaus to Cordelia, the load center of the Pacific Gas & Electric Company. At this point step-down transformers will be used for reducing the pressure to approximately 60,000 volts, permitting the power thus to be transmitted to various parts of the system: Oakland, Berkeley, Alameda, San Rafael, Santa Rosa, Vallejo, Petaluma, and northward toward Suisun, Cement, Woodland, Sacramento, Davis, Dixon, and, in fact, to any part of the vast territory already covered by the 60,000-volt network of transmission lines.

The project further includes the construction of a steel tower line from Cordelia to San Rafeal, Sausalito and Lime Point, thus providing Pacific Service to the Marin peninsula and the transmission of hydroelectric power ultimately to San Francisco.

Adverting to Lake Spaulding, this splendid reservoir site, with a capacity of 4,000,000,000 cu. ft., or nearly double the combined capacity of all of the reservoirs in the South Yuba system, will be formed by the construction of a huge monolith of cyclopean concrete. The dam will be of gravity type section, arched upstream for an additional factor of safety and a more substantial type of construction, thus insuring stability and absolute security against any possible failure. The dam will be 300 ft. in height and will be built somewhat similar to the New Croton and Croton Falls dams of the New York Water Supply, and of cross section, approximating the Roosevelt Dam, which impounds such a vast quantity of water for the Salt River project, a part of the reclamation work of the United States Government. The reservoir is situated about two miles northeast of Smart Station, on the Southern Pacific Railroad, at an elevation of 4,600 ft. The proximity of the site to the main line of the Southern Pacific is indeed fortunate and a spur track directly to the location of the dam will greatly facilitate and economize the work. This track has already been constructed and work on the cableways, sand and gravel bunkers and tunnel outlet is now rapidly progressing.

In connection with this work at Lake Spaulding, not the least important is the operation of the old Birce & Smart sawmill, now owned by the Pacific Gas & Electric Company. The high dam will flood 700 acres of land which now contains over 1,000,000 board ft. of standing timber, which the mill has been converting into ties, boards and dimension stuff at the rate of from twenty to thirty thousand board ft. of lumber per day. There is already a good stock of lumber on hand for the work as it progresses. The clearing of the reservoir site will therefore be practically completed and, at the same time, a most valuable use of the timber will be made. Any surplus will be used in the maintenance and repairs of the many flumes on the South Yuba system. A solid rock concrete-lined tunnel, 4427 ft. long, will form the reservoir outlet and will conduct the water to the upper end of a concrete-lined canal 8½ miles in length, having a capacity of 400 second ft., or 16,000 miners' inches. This canal will contain no flumes but will have a short syphon near the lower end leading to the forebay previously mentioned. The regulating reservoir site is a large flat area capable of being converted into a forebay of 400 acre ft. capacity without excessive cost, and will thus provide sufficient water to run the entire plant for twenty-four hours, and will amply provide for peak load and other power fluctuations—a most valuable adjunct to a plant of this size and importance.

The forebay will be constructed by excavating the earth and loose material from the basin, forming a dam about 35 ft. in height on the south or lower side of the slope. The earth embankment will be made according to the most approved methods, namely, by placing the material in thin layers, thoroughly dampening, rolling and compacting, thus making the dam absolutely impervious. Two riveted steel pipe lines leading from this regulating reservoir will be 6300 ft. long and 72 inches in diameter at the upper end. The lower end will be provided with "Y" branches, castings and suitable gates and nozzles for conducting the water to the eight water wheels, each with a capacity of 9000 horsepower. The pressure at the nozzle of the 7-inch stream impinging upon the water wheel buckets will be 585 pounds per square inch, or nearly three times the high steam pressure used by the big locomotives of the Southern Pacific Company.

That this work, both in the field and office, is most actively carried on is shown by the fact that the plans and specifications of the water wheels, generators, transformers, steel towers, and pipe lines are already in the hands of the manufacturers, and bids will be received by the time this magazine goes to press. Excavation for the power house foundations began immediately upon securing the necessary permission from the Railroad Commission, and camps were established along the canal line from the Lake Spaulding Dam to the forebay. At the power house sites at this time 1400 men are busily engaged in clearing, excavating and carrying on the many phases of work necessary to a project of this kind, while the engineers of the company have been for months preparing all necessary details, plans and specifications for each and every individual part of the equipment for the necessary prosecution and construction of the work, as well as the large units which will be used in the final operation of the completed plant. The canal line for its entire length has already been cleared of all brush and trees, and excavation is actively in progress. The forebay site has been cleared of all loose material and objectionable surface earth which could not be used in the main body of the embankment, and some three hundred head of stock and one hundred and fifty men are now actively carrying on the excavating and placing of the earth for the embankment.

Preliminary and final surveys and many of the rights-of-way have been already secured for the 118-mile transmission line from the Drum Power House to Cordelia, and work on the foundations for this line will begin within a few weeks, so that the towers can be installed, assembled and erected in the early spring of 1913, thus insuring and guaranteeing completion of the line before the fall of next year, which will witness, without doubt, the final completion of the entire project.

Looking Toward the Dam-Site from Up-Stream.

THE SPAULDING DAM.

BY HERMANN SCHUSSLER.

Recently it was my good fortune to accompany Mr. J. A. Britton, vice president and general manager, and Mr. J. H. Wise, assistant general manager, of the Pacific Gas & Electric Company, to the site of the large storage reservoir which the company proposes to construct on the site of the old reservoir there, known as "Lake Spaulding."

The dam will be located a short distance down stream from Lake Spaulding; and, owing to its contemplated height of 300 ft. above the bed of the river, the original reservoir will be entirely submerged. While the length of the proposed dam will be only 60 ft. at the bottom of the gorge, its length along the finished curved top, will be 900 ft.

The reservoir to be created by the erection of the new dam will have a surface area of about 700 acres, and a storage capacity of 4000 million cu. ft. or 30,000 million gallons.

The watershed directly tributary to the reservoir has an area of fully 120 square miles with an average annual rainfall of between 60 and 70 inches.

Owing to the generally rocky and precipitous character of the water shed, the percentage which the seasonal surface run-off bears to the gross precipitation on the watershed will be fully 50 per cent.

Thus, the average, annual water product discharging from the above watershed into the proposed new Lake Spaulding will be equal to fully 8000 million cu. ft. or 60,000 million gallons, or double the storage capacity of the proposed reservoir.

By the construction of the proposed main concrete dam across the gorge of the South Yuba, the water surface of the proposed storage reservoir will be raised to such a height that it will be necessary to construct at two points of the divide on the northerly side of the lake two separate, comparatively low concrete dams. One or both of these, will be so arranged that they will form capacious waste-weirs, or spillways, for such waters as will have to be wasted from the reservoir when the latter—during or immediately after the snow-melting season—has been filled to its utmost capacity. By the construction of these spillways the necessity of discharging such waste-waters over the top of the high main concrete dam will be avoided.

The hydrographic features, thus briefly outlined, show that the reliability and constancy of the water supply from this source will be practically ideal.

In fact, I should be very much tempted—in spite of the already great height of 300 ft. of the contemplated main dam—to still further increase the same, in order to bring the storage capacity more nearly up to the average annual water product of the tributary watershed—if it were not for the necessity of having also to raise at considerable cost the two above mentioned subsidiary lower spillway-dams.

The ideal location of the proposed main dam in the precipitous narrow gorge of the Yuba, with its practically homogeneous rock bluffs on both sides of the river, fully excuses and justifies my above expressed desire of increasing the height of the dam above the contemplated height of 300 ft.

When, about seven years ago, I stood—like last week—on the rock bluff, the main body of which will form the southerly abutment of the proposed arch-shaped dam, I could not help feeling and expressing delight at seeing one of the most admirably formed dam sites, that I had ever beheld—admirable both from a topographical as well as geological point of view.

The dam, in all probability will be built with the system of interlocking, keystone-shaped concrete

blocks—built in place alternately—containing not less than 400 cubic yards each—and similar to the dam built by me in San Mateo County, where it forms the large Crystal Springs Reservoir of the Spring Valley Water Company. This same method was successfully employed in the construction of the large Barren-Jack dam in Australia.

The successful manner in which the above main Crystal Springs concrete dam resisted the tremendous wrenching to which it was subjected by the earthquake of April 18th, 1906—although located close to the main fault-line—fully proved that the method of construction adopted by me, coupled with the first-class materials and thorough workmanship employed in its erection, fully justified the great care bestowed upon every portion of this important work.

The rock required for the concrete for the new Lake Spaulding dam—estimated at between 250,000 and 300,000 cubic yards of concrete—will be quarried out of or near the bluff over-topping the southerly abutment of the same, while the necessary gravel and sand is found of excellent sharp-grained quality and in great abundance, in a large nearby moraine—a remnant of the glacial period.

The successful construction and completion of the proposed new concrete dam for the greater Lake Spaulding—owing to its height as well as its great economic value for developing the resources of our state, will not only reflect credit upon the company that had the foresight and boldness to undertake this magnificent work—but also upon the engineering talent employed in its conception, design and successful construction.

NATURAL GAS AUTOMOBILE.

The successful use of natural gas as a motive power was recently demonstrated by A. M. Schenck of Wheeling, W. Va., with a natural gas driven motor on the streets of Pittsburgh. A gasoline tank was provided as a reserve and it was possible to shift from one fuel to the other without loss of time and while the car was running, by means of a small lever at the side of the driver's seat.

The gas is carried in three pressure bottles, each containing 140 cu. ft. at 1500 lb. pressure, from which it is brought down in one step to 100 lb. pressure. From this point it passes through a regulator, then into a device corresponding to a carburetor, at a pressure of only two ounces above gauge or atmospheric pressure. At this point the gas is mixed with air, and the mixture is drawn into the engine on the suction stroke.

There is an important difference between this and the gasoline system, for which economy is claimed,—the gas contains approximately 23,000 heat units as against 18,000 for good gasoline.

The equipment department of the American Can Company in a report filed with that company presented the following cost figures:

Number of ft. natural gas used per mile, 12½.
Cost of gas and compressing, 50 cents thousand ft.
Cost per mile, .0065.
(Estimating that one gallon gasoline will run truck 6 miles).

Cost of gasoline per gallon	.20
Cost per mile	.0333
Cost per mile, gasoline	.0333
Cost per mile, natural gas	.0065
Saving per mile	.0268

COST OF ELECTRIC PUMPING PLANTS IN BRITISH COLUMBIA.

BY B. A. ETCHEVERRY.[1]

First Cost of Plant.

The first cost of a pumping plant depends on the grade of machinery, the cost of transportation, the expense of installation. Because of these factors accurate estimates of cost can not be given. However, the approximate cost values given below will be of value to the land owner who is considering the feasibility of a pumping plant. The values given represent the prices at Vancouver and do not include transportation and installation.

Approximate Cost of Single Stage Centrifugal Pumps.

No. of pump.	Capacity in U. S. gallons per minute.	Cost
2	100	$ 70
2½	150	85
3	225	95
3½	300	110
4	400	120
5	700	140
6	900	190
7	1200	240
8	1600	285

The cost of two step centrifugal pumps of the same sizes will be about four times the values given above.

Approximate Cost of Triplex Single Acting Power Pump.

Diameter of water cylinder.	Length of stroke in inches.	Capacity in U. S. gals. per minute.	Height of lift.	Cost.
4	8	65	75 to 100 ft.	$ 270
5	10	130	"	400
6	12	220	"	550
4	6	48	175	300
5	8	91	"	440
7	8	180	"	600
8	10	270	"	950
8	12	310	"	1000

Approximate Cost of Electric Motors, Gasoline Engines and Simple Slide Valve, Non-condensing Steam Engine, With Locomotive Boiler and Auxiliaries.

Horse Power	Cost of electric motors. 1200 rev. per minute.	Cost of gasoline engines.	Cost of steam engines.
2	$ 90	......	......
3	110	......	......
5	160	$ 475	$ 650
10	260	725	800
15	280	900	1,000
20	340	1,100	1,200
30	410	1,600	1,500
35	410	1,600	1,500
40	...	2,100	1,700

Cost of Accessories and Installation.

The above costs are for the pumps and engine and do not include the accessories, the foundation, the labor of installation, and the housing. For an electric plant the cost of transformers should be added unless these are supplied by the electric company. The accessories will include the suction and discharge pipes, the valves and fittings, the priming pump, the connection between pump and engine. The suction pipe is usually made of steel; the discharge pipe may be steel or wood banded pipe and should cost delivered at different points in the arid part of British Columbia about as follows:

Cost of Pipes Safe for 150 Feet Head.

Diameter of pipe.	Cost per foot of wood banded pipe.	Cost per foot of steel pipe.
4 inches	$ .20	$ .30
6	.30	.50
8	.40	.80
10	.55	1.10
12	.65	1.35
14	.75	1.60
16	.95	2.00
18	1.10	2.50
20	1.44	3.00

For a rough estimate the total cost of valves, priming pump, all fittings and suction pipe, but not discharge pipe, may be taken as about 10 per cent. of

[1]Head of Department of Irrigation, University of California.

the cost of pump and engine for a gasoline or steam plant and 20 per cent for an electric plant. The cost of installation should not exceed 5 per cent. The cost of a building to house the plant will range from about $25 for a small plant to $100 or more for a larger plant. The cost of transportation and hauling will depend on the railway charge from Vancouver and on the distance from the station to point of installation.

Fuel Consumption and Fuel Cost.

The selection between a steam engine, gasoline engine and an electric motor will depend to some extent on the comparative cost of coal, gasoline, and electrical energy.

A gasoline engine is usually guaranteed for a fuel consumption of 1-9 to 1-10 of an Imperial gallon of gasoline per rated or brake horsepower per hour. A new engine well adjusted will come up to this efficiency, but an engine that has been operated some time will consume about 1-7 of an Imperial gallon of engine gasoline or distillate per brake horsepower per hour.

The fuel consumption of a steam engine will vary greatly on the type of boiler and engine. A small slide valve non-condensing engine under 25 h.p. will use probably 50 to 60 lb. of steam per brake horsepower per hour. A locomotive type of boiler should give 5 or 6 lb. of steam for 1 lb. of coal. Therefore, a small steam engine under 25 horsepower should consume about 10 lb. of coal per brake horsepower per hour. Steam engines of the same type from 30 to 50 horsepower will consume from 5 to 8 lb. of coal per brake horsepower per hour.

Electrical energy is measured in kilowatts. A kilowatt is equal to 1 1-3 horsepower, but because of the loss of energy in the motor, 1 kilowatt will usually give about 1.1 brake horsepower. Based on this figure 1 brake horsepower hour is equal to 9-10 of a kilowatt hour.

The above values show that to produce 1 brake horsepower per hour, it requires either 1-7 of an Imperial gallon of distillate, about 10 lb. of coal, or 9-10 of a kilowatt hour. Based on these figures the table below shows the cost of fuel per brake horsepower per hour for several equivalent cost values of fuel. In the table is also given the fuel cost of pumping one acre foot of water through a lift of one foot, assuming plant efficiency of 50 per cent and 75 per cent.

Equivalent units costs of fuel.			Fuel costs (in cents).		
Cost of gasoline in cents per Imp. gallon.	Cost of coal in dollars per ton (2,000 lb.)	Cost of electricity in cents per K. W. hour.	Per brake h. p. per hour in cents.	Per acre foot of water lifted 1 foot high. 50% efficiency.	75% efficiency.
14	$4.00	2.25	2.0	5.5	3.65
16	4.55	2.50	2.30	6.3	4.20
18	5.15	2.85	2.55	7.0	4.70
20	5.70	3.20	2.85	7.8	5.25
22	6.30	3.50	3.15	8.65	5.75
24	6.85	3.80	3.45	9.5	6.30
26	7.40	4.15	3.70	10.20	6.80

The price of engine gasoline bought in drums is about 24 cents per gallon delivered at Kamloops and 26 cents per gallon at Okanagan points. These prices are equivalent to coal at $6.85 to $7.40 a ton or electricity at 3.80 to 4.15 cents a kilowatt hour. The fuel cost is, however, only a part of the total cost of pumping.

Fixed Charges and Attendance.

A.—Fixed Charges.

The cost of installation represents a capital which if invested would bring in an income represented by the interest. It is therefore necessary to consider this interest as part of the cost of operation. To this should be added the annual cost of repairs, maintenance and renewal. These items of cost represent the fixed charges. After 6 or 8 years a gasoline engine may need to have its cylinder rebored and a new piston provided, the cost of which is about one-fourth the cost of a new engine. With ordinary care the life of a gasoline engine may be taken as 10 years; the life of an electric motor about 15 to 20 years. The fixed charges on the entire plant may be taken as follows:

Fixed Charges.

	Gasoline engine plant.	Electric plant.	Steam engine plant (small).
Depreciation and renewal...	8 per cent	5 per cent	8 per cent
Repairs and maintenance....	3	1	2
Interest	6	6	6
	17	12	16

B.—Attendance.

An electric motor requires a minimum of attendance, small gasoline plants require frequent inspection, and steam engines require a licensed engineer and for that reason can not be economically used for small plants operated during short periods. The cost of attendance for an electric motor pumping plant should not exceed 5 cents per hour, for a gasoline engine plant 10 cents per hour and for a steam engine plant 40 cents per hour. While electric motors and gasoline engines are usually operated by the orchardist or irrigator, his time is valuable and a charge should be made for it.

Final Selection of Type of Plant.

The final selection of a pumping plant should be based on a careful consideration of the factors stated above. The best size of plant, the period of operation, the kind of engine or driving power, can only be correctly determined by a final consideration of cost of installation and cost of operation. For small plants operated for short periods during the irrigation season steam engines are not to be considered even where coal is cheap because they must be operated by a licensed engineer whose salary would be excessive in proportion to the saving obtained by using cheap coal. Where electric power is available the choice is between a gasoline engine and an electric motor. The electric motor requires minimum attendance, it is reliable and its first cost is much less than that of a gasoline engine. For these reasons if electric power is available, an electric motor is preferable to a gasoline engine and will prove far more economical than a gasoline, even should the cost of electrical energy be higher than the fuel cost for a gasoline engine, which is not likely to obtain in British Columbia because of the high cost of engine gasoline or distillate.

At Grand Forks, British Columbia, electricity was sold for pumping plants at the rate of 3 cents per kilowatt hour; as far as fuel cost is concerned this is equivalent to gasoline at about 19 cents a gallon. This is less than the cost at which gasoline can be obtained and in addition gives the advantages stated above.

The application of the above information and cost data to any particular case is illustrated by the following examples:

First example: A 20 acre orchard is to be irrigated by pumping. The quantity to be applied is 6 inches per month and the total depth in one season, 18 inches. The lift is 50 ft. and the discharge pipe 200 ft. long. Engine gasoline costs 24 cents per Imperial gallon. Assuming the pump is operated 1-3 of the time or ten twenty-four hour days each month, this will require a pump capacity of 225 gallons per minute, which is obtained with a No. 3 centrifugal pump and 7 horsepower engine. The discharge pipe will be 4 in. in diameter. The first cost and total cost of operation will be about as follows:

First Cost of Plant.

No. 3 centrifugal pump	$ 95
7 H. P. gasoline engine	600
Priming pump, suction pipe, fittings, etc	70
Freight charges and hauling	30
200 feet of 4-inch wood banded discharge pipe	80
Installation, 6% of cost	40
Building to house plant	40
Total cost	$955

Total Annual Cost of Operation.

Fuel cost of 7 brake H. P. engine for 3 periods of 10 days each or 720 hours is equal to 720x7x3.45—17,000c or	$170
Fixed charges at 17 per cent. of first cost	160
Attendance 720 hours at 10 cents	72
Total cost for 20 acres	$402
Cost per acre	$20.10

Where electric power is obtainable the first cost of plant and annual cost of operation for the same conditions, assuming the unit cost of electric power to be 3 cents per kilowatt hour would be:

First cost of plant	$530.00
Total annual cost of operation	245.00
Cost per acre	12.25

Tabulated below are the first costs of gasoline engine pumping plants and the costs of operation for orchards of 20, 40 and 80 acres for lifts of 50 ft. and 150 ft. and for different periods of operation. For the higher lift single acting triplex pumps are used. The costs given are based on gasoline at 24 cents a gallon, for a depth of irrigation of 18 in. for the lower lift and depths of 18 in. and 12 in. for the higher lift, it being assumed that by careful use of water, if the soil is retentive, 12 in. may be sufficient. The discharge pipe is assumed to be 200 ft. long.

Cost of Pumping With Gasoline Engines and Centrifugal Pumps for 50-Foot Lift, Gasoline 24 Cents a Gallon.

Area in Acres.	Number of days operated per month.	Pump Capacity.	No. of Pump.	Horsepower of engine.	First cost of installation.	Annual Cost of operation per acre; 18 in, depth of water applied. Fuel.	Fixed charges.	Attendance.	Total.
20	5½	400	4	12	$1,225	$ 8.25	$10.50	$1.90	$20.65
	10	225	3	7	955	8.75	8.10	3.60	20.45
	20	113	2	5	725	12.00	6.20	7.20	25.40
40	5	900	6	25	1,855	7.75	7.90	.90	16.55
	11	400	4	12	1,225	8.25	5.25	2.00	15.50
	20	225	3	7	955	8.75	4.10	3.60	16.45
80	10	900	6	25	1,855	7.75	4.00	.90	12.65
	22	400	4	12	1,225	8.25	2.60	2.00	12.85

Cost of Pumping With Gasoline Engines and Single Acting Triplex Pumps for 150 Foot Lift.

Area in Acres.	Number days per month.	Capacity.	Horsepower of engine.	First cost of installation.	Annual Cost of operation per acre for a depth of irrigation water of 18 inches. Fuel.	Fixed Charges.	Attendance.	Total.
20	8.3	270	15	$2,370	$15.60	$20.00	$3.00	$38.50
	12.5	180	10	1,740	15.50	14.80	4.50	34.80
	25.0	90	6	1,280	18.75	10.90	9.00	38.65
40	13.25	340	18	2,760	15.00	11.70	2.40	29.10
	16.66	270	15	2,370	15.50	10.00	3.00	28.50
	25.0	180	10	1,740	15.60	7.40	4.50	27.50
80	26.5	340	18	2,760	15.00	5.85	2.40	23.25

The capacities of pumps, especially plunger pumps, and the sizes of engines, vary with the different makes, and for that reason the sizes given are not always obtainable, but sizes approximating these can be used in place.

The above cost estimates are only approximate. They are based on the conditions stated above and are not applicable to all cases because of the varying conditions which make the installation of nearly every pumping plant a special problem. The estimates are made for gasoline engines and are considerably higher than for electric motors. The first example showed that with an electric plant the cost of pumping was only 60 per cent of the cost with a gasoline plant. The tabulated values show the following interesting results:

1st. The cost per acre of pumping is much larger for a small area than for a large area.

2d. The cost per acre does not vary considerably with the period of operation, and in some cases a plant moderately large operating for a shorter period will cost less per acre than a smaller plant operating a longer period. This is due to the lower fuel cost obtained with the larger more efficient plant and the decreased cost of attendance for the shorter period of operation which overbalances the larger fixed charges. Even should the resulting cost be smaller for the smaller plant, the inconvenience due to pumping for a long period and the extra labor in irrigation may overbalance the saving in cost.

3d. For the lifts assumed a period of operation equal to about ten twenty-four hour days during the month or one-third of the time during the irrigation season seems to be preferable with the centrifugal pump. With the higher price triplex plunger pumps a period of operation of one-third to two-thirds of the time is preferable.

Co-operative Pumping.

The lower cost per acre for larger areas shows the advantages to be gained by co-operation between small owners. By uniting and installing a large plant instead of several smaller plants the cost of installation and operation is very much reduced and the plant can be given more competent attention which relieves the orchardist and increases the life of the plant.

Where by such co-operation several hundred acres can be brought together, a central steam plant to generate electric power, which is transmitted to the several electric motor pumping plants, is the most economical and best solution.

For separate plants above 20 or 40 horsepower, gas producer plants connected to gas engines will furnish the cheapest power. These plants are reliable and easily operated. They consist of the producer in which hard coal is placed and through a process of partial combustion, in presence of air and steam, forms the gas which operates the engine. Gas producers operated on hard or anthracite coal have been in successful operation for a number of years and those operated on soft or bituminous coal are coming into use, but have not been very successful. The fuel consumption is very low, usually from 1 to 1½ lb. of coal per horsepower for one hour, or ½ to ¾ of a cent per horsepower for one hour with hard coal at $10 per ton. This is from 5 to 7 times less than

the fuel cost with gasoline at 24 cents a gallon. Producer gas plants are more expensive than gasoline engines and for smaller plants the fuel economy will be overbalanced by the larger interest and depreciation charges. For very large single plants high duty steam engines will be the most economical form of installation.

Limit of Economical Pumping.

The cases previously worked out for gasoline engine pumping plants show that for small tracts of 20 to 80 acres the cost of lifting sufficient water to give a depth of irrigation water of 18 in. will range for a lift of 50 ft. from about $12.50 per acre for the larger area to about $20.00 per acre for the smaller area, and for lifts of 150 ft. the respective costs are about $23 and $35 per acre. These costs may seem high as compared with gravity water, but to obtain an idea of the economy and feasibility of developing water by pumping, comparisons must be made with the value of irrigation water in the irrigated districts of British Columbia and also in other localities under the same conditions. In British Columbia, up to the present, gravity water obtainable without pumping has been quite plentiful. For that reason pumping has not been necessary, and very few pumping plants have been constructed. However, water is becoming more valuable and the steps which many irrigation companies in British Columbia are taking to conserve water and prevent losses of transportation by carrying the water in concrete lined canals and in pipes constructed at considerable expense, show that water has become sufficiently valuable to justify pumping. If a comparison is made with water thus obtained, we find that the cost of construction of a well constructed system may go up to $50 or $60 an acre and even higher. This cost is charged up to the land which is sold to the orchardist and in addition reasonable profit is made on the value of the land. It is probably conservative to assume that land under an irrigation system will cost at least $100 an acre more than similar land for which there is no gravity supply. The chief advantage of gravity systems is the low annual cost of operation, usually less than $6 per acre, but if to this be added the interest on the difference in cost between land under the irrigation system and land which is to be supplied by pumping, assumed at $100, the total annual cost may be $10 to $15 an acre. This is about equal to the cost of pumping with gasoline engines to a height of 50 ft. and about half as large as for lifts of 150 ft. Where electric power is available or for large pumping plants the cost of pumping would compare very favorably with gravity water even for higher lifts than those stated above. There are many contemplated hydroelectric power installations in the irrigated regions of British Columbia which, if materialized, will be of great value in extending the area irrigated by pumping.

A consideration of pumping in other districts is of interest to show its feasibility. In eastern Washington water is being pumped in one case to an elevation of 250 ft. above the source of supply. In the citrus district of southern California lifts above 200 ft. are not unusual and it is considered profitable to pump 460 ft. In the Pomona district of southern California, the cost of pumped water averages $15 per acre for one acre foot when purchased from irrigation companies, while for smaller private plants the cost is often greater. In 1905 the Irrigation Investigations Office of the United States Department of Agriculture made tests on various pumping plants and these show that the cost of pumping at private plants of 10 to 100 horsepower with lifts of 100 to 300 ft. varied from $10 to $90 per acre for one acre foot of water.

There is a limit beyond which it is not economically feasible to pump. In the California citrus districts lifts above 400 ft. have been profitable. For the orchard lands of British Columbia equally high lifts should be profitable, for the net return per acre from a good apple orchard is usually more than that from a citrus orchard. A citrus orchard 10 years old should average a net profit of $100 to $150 per acre. The net profits from apple orchards 10 to 12 years old in the Yakima Valley are given in bulletins of the United States Department of Agriculture as $200 to $600 per acre. With profits larger than those obtained from citrus orchards in southern California, what has been considered feasible in pumping there is at least equally so for the apple orchards of British Columbia when no other more economical source of water supply is available. However, for small pumping plants and small areas the writer believes that it is well not to exceed 200 ft., while for larger plants lifts of 400 ft. may be economically feasible.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

Applications.

Central California Gas Company to change authorized bonded indebtedness from $300,000 to $500,000, and to issue bonds in denomination of $1000 instead of $500.

San Diego Consolidated Gas & Electric Company, to issue $250,000 in bonds.

Board of Supervisors of Contra Costa County, to determine terms of overhead crossing, near Peyton.

Southern Pacific and Holton Interurban Railway, for approval of lease of track from El Centro west.

Big Four Electric Railway Company, to issue 100,000 shares of stock.

Answers.

Great Western Power Company, denying allegations of Pacific Telephone & Telegraph Company that its power line interfered with telephone lines between Napa and Sonoma.

Palo Alto Gas Company to city of Palo Alto, offering reduction in rate to $1.40 per 1000, or on sliding scale from $1.45 per 1000 to $1.25 per 1000 feet.

Pacific Telephone & Telegraph Company, to complaint of San Leandro Chamber of Commerce, denying inefficiency of service and discrimination.

Decisions and Orders.

Betts vs. Peoples Water Company, holding that water company should not divert water impounded for use of Claremont tract.

Northern California Power Company, holding that the company might issue $500,000 of 6 per cent debenture notes, on condition that it file stipulation to assess within eighteen months if directed by the Commission.

Los Angeles & San Diego Beach Railway Company, declaring passenger rates unjust and ordering reductions.

Indian Valley Electric Light & Power Company, allowing issue of notes of $65,228.

Mt. Konecti Light & Power Company, holding that company could operate in territory desired in Lake County without Commission's approval.

WESTERN LAWS OF ELECTRICITY AND WATER

The Desideratum in Legislation Regarding the Public Waters.

BY A. E. CHANDLER.

The legal principles governing the use of water are the result of judicial decisions rather than legislation. Just as the doctrine of riparian rights is the outgrowth of the old common law as interpreted by the English courts, so the doctrine of prior appropriation is the outgrowth of the customs of the pioneer miners and irrigators as interpreted by the Western courts. To continue to exist as common law a legal principle must be reasonably adapted to the time and the place. The strictly arid states long ago abrogated the doctrine of riparian rights because it was wholly unsuited to conditions there existing, and California has refused to follow the English common law rule of percolating waters for the same reason.

Riparian Rights.

The Western states still tolerating even a modified riparian doctrine are only semi-arid and naturally the older and larger cities are in the semi-humid section. It is therefore not strange that their supreme courts still find some virtue in the doctrine. Where irrigation is not the first aid to successful agriculture the riparian doctrine seems rational, and it would be at least unusual for one residing in a non-irrigated section and trained in the common law of the books to consider the doctrine of prior appropriation as other than a makeshift of frontier camps. During the last decade, however, irrigation has been given a tremendous impetus and the great size of the many projects undertaken in the semi-arid states has done much to show the unsuitability of the riparian doctrine.

The doctrine of prior appropriation on the contrary is proving more and more adapted to the needs of growing communities with restricted water supplies. The cardinal principle being reasonable use and the elimination of waste, no ditch is allowed to divert water unless there is actual immediate need for the use thereof. The popular notion of the exclusive ownership of water finds no authorization in the books. On the contrary expressions like the following show the attitude of the courts:

> It is the policy of the law that the best methods should be used and no person allowed more water than is necessary, when properly applied, and thus a larger acreage may be made productive by its extended application. *Little Walla Irr. Union v. Finis Irr. Co.—Ore.*—124 Pac. 668.

As an instrument of the best development the superior claims of the doctrine of prior appropriation is perhaps nowhere better shown than in the very recent case of Schodde v. Twin Falls Land & Water Company, decided by the Supreme Court of the United States on April 1, 1912, (32 Sup. Ct. Rep. 479). The plaintiff owns lands riparian to the Snake River in Idaho and by means of a number of water wheels, from 24 to 34 ft. in diameter, elevated the waters thereof to irrigate his lands. The defendant company by the construction of the Twin Falls dam and the consequent back water destroyed the current and rendered his wheels useless. If the doctrine of riparian rights were recognized in Idaho the remedy of the plaintiff would have been unquestioned, but the doctrine was long ago abrogated. The Supreme Court in affirming a judgment of dismissal quotes with approval the following words of the trial court:

> It is unquestioned that what he has actually diverted and used upon his land, he has appropriated; but can it be said that all the water he uses or needs to operate his wheels is an appropriation? As before suggested there is neither statutory nor judicial authority that such a use is an appropriation. Such a use also lacks one of the essential attributes of an appropriation,—it is not reasonable.

The opinion is but another illustration of the point that the doctrine of prior appropriation aims towards the highest use and greatest development, and is adapted to the time and the place.

Despite the weakness of the riparian doctrine, it is the accepted rule of property in the semi-humid states. As it has been fixed upon us by the courts, legislation attempting to abrogate it for lands now in private ownership, would be futile and should not be attempted. The suggestion has been made to lessen the statutory period now allowed a riparian owner in which to bring an action for wrongful diversion. It is a practical idea and worthy of adoption, but any change in the doctrine itself must be made by the courts.

Percolating Waters.

California is the only irrigation state which does not follow the common law rule that percolating waters belong to the owner of the soil. Excepting California there can be no need of legislation regarding the use of such waters.

In California the courts have departed from the common law and have laid down a new rule somewhat analogous to that of riparian rights in the surface streams. Under the new rule the owner of land overlying a body of percolating water is entitled only to a reasonable use of such upon his overlying land and may enjoin any diversion of such water to lands not overlying which will interfere with his reasonable use. Where a surplus exists, the court may fix the time and amounts for the pumping of percolating water to lands not overlying.

To be constitutional any legislation in California regarding percolating waters must be declaratory of the principles established by the courts. The scientific and technical questions which arise in the determination of the source and amount of percolating waters are so many and so difficult to positively answer, that few claimants will be satisfied with a determination not approved by the higher courts. Until administrative officers have demonstrated their efficiency in determining rights to the surface flow, there is little hope of them being given an opportunity to deal with percolating waters. At the present time the courts have established rules of their own which will conserve such waters, and those who are striving for better water legislation in California should concentrate their efforts in behalf of the surface supply.

Irrigation Versus Navigation.

As Congress has the superior right to legislate regarding the navigability of streams which may be used in interstate commerce, any conflict between the interests of irrigation and navigation rising out of the diversion of the waters of such streams cannot be anticipated and avoided by state legislation. In certain parts of the West, especially on the Colorado and Sacramento Rivers, the clash is imminent. As action by congress in favor of irrigation would be difficult to secure and of doubtful validity, the question must be settled by the communities involved. The investments in irrigation works and the industries dependent thereon are increasing each year, while other means for transportation are leaving little call for that by water.

As the War Department in order to maintain the navigability of a river may stop the diversions from the tributaries as well as from the main stream, it is clear that in most cases the material wealth of whole counties might be jeopardized. It seems certain, therefore, that public policy demands diversions of the summer flow even to the detriment of navigation, and that such conflicts will be adjusted to so allow.

"Monopoly" in Public Waters.

As ordinarily defined "monopoly" signifies that the "monopolist" has control over output and prices. So construed there can be no monopoly in the waters of our streams.

The various types of irrigation enterprises may be grouped as follows: United States Reclamation Service enterprises; Carey Act enterprises; irrigation districts; co-operative or mutual enterprises; commercial enterprises; and individual and partnership enterprises. As explained in the previous articles all of the types become mutual excepting the commercial enterprises—which supply water for compensation to parties who own no interest in the works. It has also been shown that the rates of the commercial enterprises are subject to regulation by public officers and that the water right of the enterprise belongs to the land owners and not to the operating company. It is therefore certain that so far as the water right is concerned no monopoly can exist in the irrigation business.

The expression is generally associated with the hydraulic development of electric power, but, as all public utilities are subject to rate fixing by the proper state authorities, any control of output and prices can be terminated. According to present decisions the water right of power plants is vested in the owner thereof, and this must always be the rule where the riparian right exists. In the case of appropriation rights legislation should be adopted providing that appropriations for power purposes may be authorized as indeterminate licenses and that the water right shall be considered of no value in rate fixing and in condemnation by the state or other public unit. There is no more reason why a power company should be allowed to capitalize a water right than there is for an irrigation company. In regard to other franchises the courts have been doing their part in attempting to reduce fictitious capitalization, and it is high time for all legislative bodies to positively provide for the elimination of any chance of capitalization in franchises granted by them or under their acts.

Legislation Regarding Appropriations.

Every Western state has statutes fixing the procedure to be followed in making appropriations. Arizona, California, Colorado, Kansas, Montana, Texas and Washington have departed little, if at all, from the method of posting notices. The remaining irrigation states have a central office, the state engineer's, in which applications for permission to appropriate water are filed and the conditions fixed under which the right may be perfected. Most states give this central office the right to reject an application for specified reasons—like lack of water supply, interference with prior rights, or detriment to the public welfare. Such statutes have been in force for over twenty years and there are practically no cases showing an abuse of the power of rejection.

A number of states have the central office publish the application so that all interested may be heard in regard thereto before final action thereon. This practice has proved of great benefit to both the old and the new appropriators. It gives present users an opportunity to know about and protest against any appropriation which might prove detrimental to their own, and it shows the intending appropriator the true situation before he expends any money in construction. Every state following the old method has instances of the construction of works whose operation was enjoined immediately after completion. The new method aims to eliminate such waste of time and money.

It must be emphasized that the new legislation controlling appropriations is based upon no new legal principles. It simply offers an improvement in the details of administration—just as a modern auditing system makes it possible for a business house to more easily control its operations. Under the new system the appropriator is under state control from the initiation to the completion of his project. It is a control, however, which protects, rather than prohibits, bona fide projects. In those states using the old method of posting notices the records are useless as evidences of work actually done, and one is never certain of the status of his right during construction.

In those states having no special legislation for the determination or adjudication of existing rights to the stream flow, the status of the various rights is settled only by ordinary court action. It is therefore possible to have dozens of law suits over water rights on a stream without all the water users being brought into any one of them. The new system provides a method for the determination of all rights in a single proceeding. Colorado, Idaho, Utah, North Dakota, South Dakota, Oklahoma and New Mexico provide for adjudications directly by the courts, and Wyoming, Nebraska and Nevada determine rights through a non-judicial officer or board. Oregon in 1909, combined the two by providing for a determination by a board which must be affirmed or modified by the circuit court before becoming final.

As the states in which rights are determined by a board have secured the best results, and, as the Oregon method meets the approval of those who think

such determination a strictly judicial matter, it is recommended that the Oregon method be followed in the states not included in the enumeration above. So far as bringing all claimants into one action is concerned many courts have held that they now have that power and have refused to consider the merits of a case until all claimants were made parties. The newer legislation, therefore, simply insures this being done in every case.

Although one may be successful in the ordinary lawsuits regarding water rights in those states in which the new legislation has not been adopted, he is without protection, other than further court action, if the wrongful diversions continue. Here again the abler courts have taken the matter into their own hands and have appointed officers to divide the waters in accordance with the decree and at the expense of the parties interested. The new legislation cares for the distribution by dividing the state into districts with water commissioners to apportion the waters therein in accordance with the determination of rights. The system was first introduced in Colorado in 1879 and has been accepted by all the western states with the exception of Arizona, California, Kansas, Montana, Texas and Washington.

The new legislation regarding water rights by appropriation effectively provides for the three essentials; first, the determination of existing rights; second, the distribution of water among those entitled to its use; and third, the control of the acquisition of new rights. It is working so well in the many states in which it has been adopted that there is no good reason why it should not be generally accepted. It is certain that a more general knowledge of its many good points would dispel the existing prejudice against any change in such matters and bring about the desideratum in legislation regarding our public waters.

OWL CAR SERVICE AT PORTLAND.

To ascertain whether or not own car service is actually needed in Portland, B. S. Josselyn, president of the Portland Railway, Light & Power Company, has just notified Mayor Rushlight that his operating department has arranged a service over the principal trunk lines of the city each half-hour during the night for a period of 30 days. These cars have been put into service on 17 of the 26 lines in the city. Officials of the company will keep careful check on the service and make a report at the end of 30 days as to the success or failure of the new undertaking.

SAN FRANCISCO TRANSPORTATION PROBLEM.

Preliminary Report No. 7—Part 1. Improvements in Rolling Stock.

BY BION J. ARNOLD.

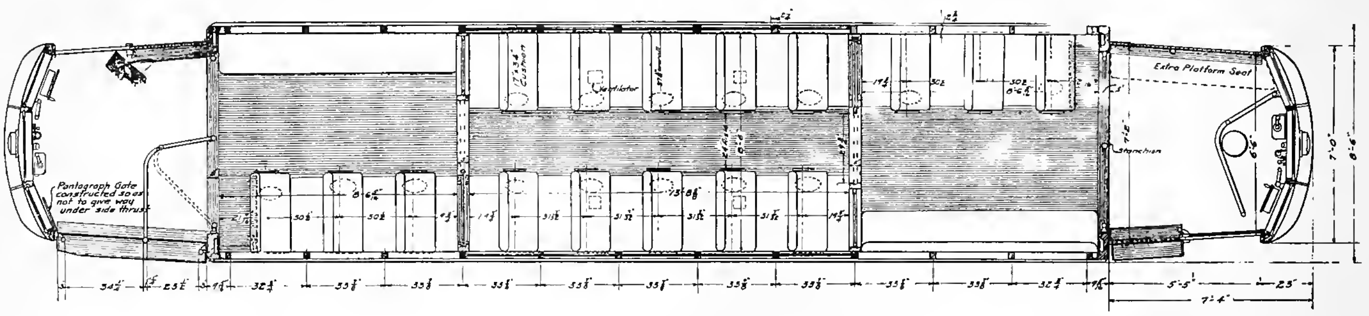
Ultimately, I shall make recommendations regarding the design of all car equipment and for a future standard car as well as for improvements in certain types of present equipment calculated to better serve the needs of the passenger traffic in San Francisco. In the present report, I shall confine myself to the so-called 1912 car, which should be considered from two standpoints:

First, whether it approximates the proper standard for future equipment, and if not,

Second, whether it is suited for operation on certain lines, in its present form.

Synopsis: The various items in the make-up of a complete car to be subjected to analysis (from the standpoint of the public) are as follows:

(1) Seating arrangement.
(2) Facilities for quick loading and unloading.
(3) Storage space—platform and car floor.
(4) Car proportions, with reference to street clearance.
(5) Height and type of steps.
(6) Ventilation and lighting.
(7) Designating signs.



PLAN

Car for Geary Street Municipal Railway.

The proportions of the 1912 car are practically the same as the later equipment now in service on Sutter street, and, excepting width, also approximate the proportions of the Geary street cars, that is, as regards truck centers, wheel base, length of body and platform, and height. The arch roof used (sometimes called the turtle-back roof), however, is new to the United Railroads practice, except in the case of a few remodeled cars which have been built in the company's shops and have been placed in service within the present year. And except in the case of these few cars, the 1912 design embodies for the first time in a San Francisco prepayment car the "California" type arrangement of car body with closed and open sections.

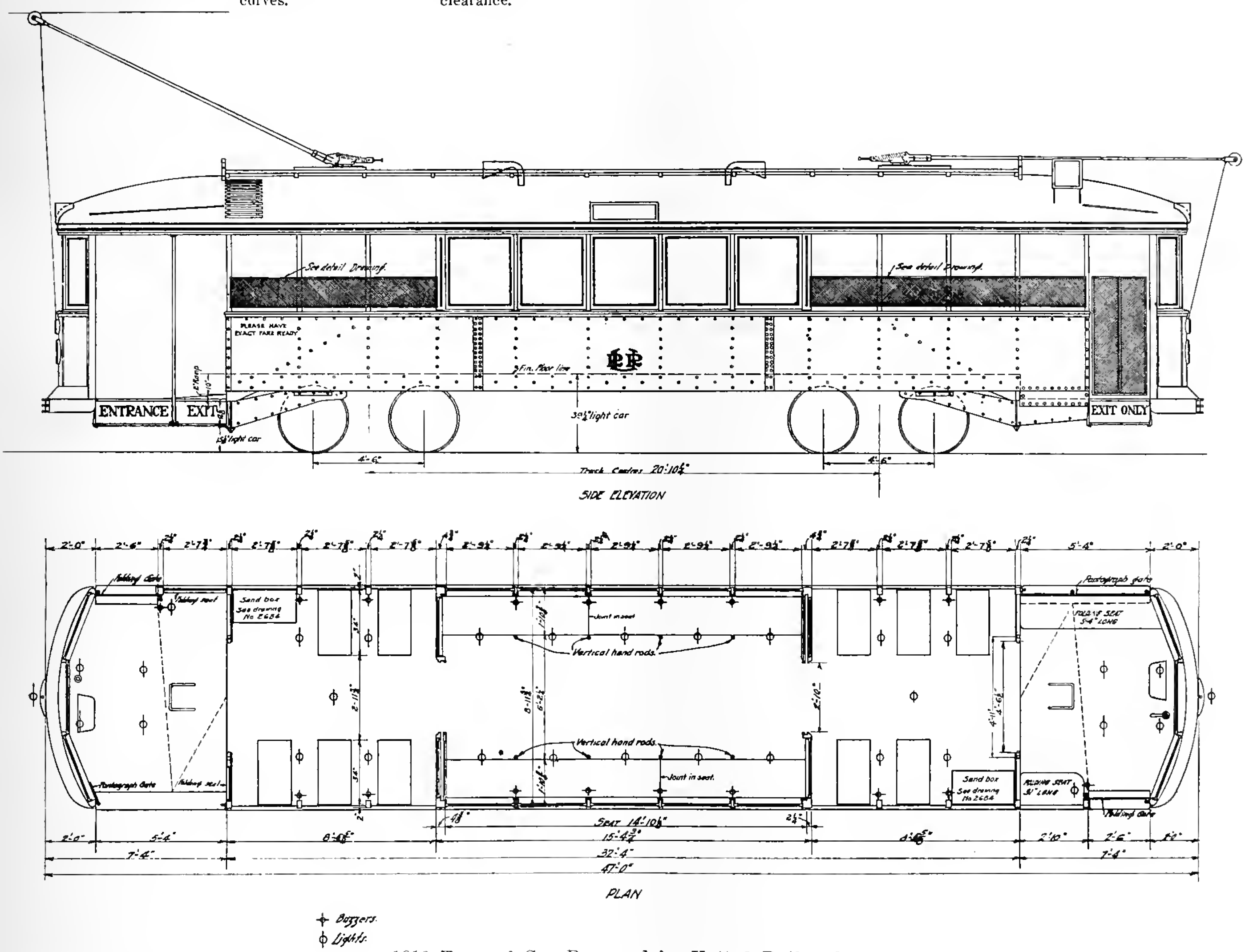
Inasmuch as this new equipment may possibly operate on the Sutter Street lines in competition with Geary Street, the following comparison will be of interest. Only such features as differ materially from the Geary Street cars or require further modifications are compared herein for discussion.

Considering these two designs together from the standpoint of the most suitable car for the City of San Francisco, I believe the Geary Street is superior, although even it may require some minor modifications as a result of experience with the initial order. The two differ materially in the matter of seating arrangement and width of car.

Comparison of Designs.

	Geary Street.	United Railroads.
1. Proportion of cross seats to total fixed seats.	73 per cent.	45 per cent.
2. Longitudinal seats.	Half of end compartments on entrance side.	Entire closed compartment.

	Geary Street.	United Railroads.
3. Average spacing of cross seats.	30½ in. to 31 7-32 in.	29 in.
4. Principal standing space.	End compartments, opposite entrance way.	Middle or closed compartment.
5. Seat proportions.	17 in x 34 in.	16 in. x 32 in.
6. Width of aisles.	24 in minimum, 28 in. at shoulder line.	About 36 in. minimum between seat hardware, 40 in. at shoulder line.
7. Width required for seat over-all.	37 1-8 in.	35 in. or more, depending upon the type used.
8. Width of car body.	8 ft. 6 in.	9 ft. 2 in.
9. Platform.	Side sills tapered to provide clearance at curves.	Sides kept straight because fenders limit clearance.
10. Minimum rear entrance width.	40 in.	32 in., due to contraction of hand-railing, locaton of and difference in types of controller.
11. Bulkhead widtb.	Open between corner posts 69 in.	False partitions, open-in 53 in.
12. Position of exit door.	Next to car-body bulkhead.	Next to car bumper, with seat intervening.
13. Minimum exit width.	29 in.	27 in.
14. Guide rail.	Uses Oakland radius bar for obtaining full step entrance. Motorman protected by movable guide rail.	Guide rail cut off at stanchion to permit full-width entrance.
15. Type of step.	Folding type, raised on blind side of car.	Fixed steps.
16. Platform fixtures.	Master type controller to reduce space occupied.	Type K control opposite narrowest entrance-way
17. Window sash.	Raise sash in closed sections.	Sash fixed.
18. Storm protection, open section.	Drop curtain.	None.
19. Ventilators.	Automatic eductors in roof, and floor intakes.	Intake and exhaust funnels.
20. Sanders.	Positive air blast sanders delivering close to wheel.	Gravity sanders.



1912 Type of Car Proposed by United Railroads.

Summary of Recommendations.

The improvements which I am able to recommend depend to a large degree upon the service intended, as suggested in the introduction; i.e., whether this new equipment is intended for general use in all parts of the city, i.e., interchangeable as regards routes, or for operation on certain lines only. In either case, I should like to see the following improvements included:

(1) Taper platform, to provide for future clearance operation.

(2) Front exit gate next to the bulkhead.

(3) Straightened guide rail to provide greater entrance width, or

(3a) Conductor's stand in center of bulkhead opening and elimination of present form of guide railing.

(4) Motorman protected by movable guide rail

(5) Geary street or equivalent seating arrangement.

(6) Cross-seat cushions 17 in. x 34 in., spacing 30 in. or more. All cushions spring backed.

(7) Raised sash in middle or closed section.

(8) Bulkhead open between corner posts.

(9) Folding steps instead of fixed steps.

(10) Storm curtains or equivalent protection.

(11) Ventilating intakes in floor or sides of the car.

(12) Positive air blast sanders.

(13) More liberal spacing per passenger for longitudinal seats where vertical stanchions are used in place of straps.

[To be continued.]

THE FACTOR OF SAFETY.

As Called for by the United States Tables of Steam Pressure on Steam Boilers.

REVISED BY J. B. WARNER.

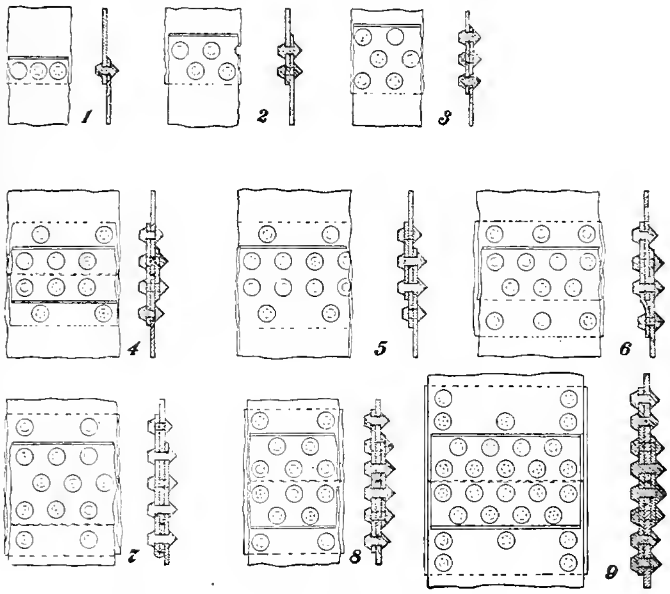
Proportions of Riveted Joints.

With the high steam pressures carried on many boilers at the present time, one of the most important factors entering into construction of steam generating apparatus is that the joints or seams shall have as high an efficiency as possible.

With a well-proportioned joint, as high a pressure may be carried with safety on a thinner sheet as on a thicker one with the joints poorly made.

In all cases the joint or seam is weaker than the solid plate.

In the following cut we give nine examples of joints in common use. There are many other kinds of seams giving a higher or lower efficiency, according to their design.



Joints.

Joint No. 1, is a single-riveted lap joint, with the rivets in single shear.

No. 2, double-riveted lap joint, rivets in single shear.

No. 3, triple-riveted lap joint, rivets in single shear.

No. 4, a double-welt butt joint, with two rivets in double shear, and one in single shear.

No. 5, single-welt lap joint, all the rivets in single shear.

No. 6, single-welt lap joint, all the rivets in single shear.

No. 7, single-welt lap joint, all the rivets in single shear.

No. 8, double-welt butt joint, with four rivets in double shear, and one in single shear.

No. 9, Double-welt butt joint, with eight rivets in double shear, and three in single shear.

When the above joints are properly proportioned the efficiency, percentage, or proportion of strength to the strength of the solid plate, should be as follows:

Joint No. 1....51.4 per cent to 58.6 per cent
Joint No. 2....67.3 per cent to 73.9 per cent
Joint No. 3....72 per cent to 75 per cent
Joint No. 4....80 per cent to 81 per cent
Joint No. 5....80 per cent to 82 per cent
Joint No. 6....77 per cetn to 79 per cent
Joint No. 7....85 per cent to 87 per cent
Joint No. 8....86 per cent to 87.5 per cent
Joint No. 9....93 per cent to 94 per cent

Where a single strap is used it should be of the same thickness, and of as good quality as the shell plate. Where double-butt straps are used they should each be at least three-fourths the thickness of the plate.

In the United States Rules and Regulations Governing the Inspection of Steel Vessels, and also in "Marine Engineering," by Seaton, it will be noticed that they recommend that each of the straps shall not be of less thickness than five-eighths the thickness of the shell plate. In many cases, if only that thickness were used, they would not be of sufficient strength, after drilling for the rivet holes, to bring the joint up to the proper standard. We, therefore, recommend that they each be three-fourths the thickness of the shell plate, to prevent failure of the joint in the straps.

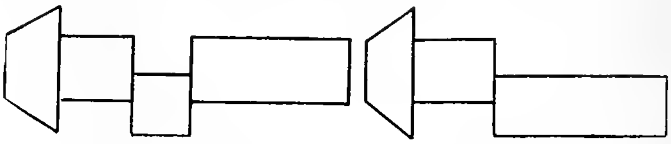
The rivets being one of the main factors in a joint, we append the following table of the shearing strength of iron and steel rivets, in single and double shear.

The rivet hole is usually one-sixteenth of an inch larger than the rivet before being driven. We have, therefore, figured the resistance, from the size of the hole which the rivet should fill when driven.

It is found that the shearing resistance of a rivet in double shear is 75 per cent greater than in single shear, also, that the average of good iron rivets will shear at 38,000 pounds per square inch of section in single shear, and at 66,500 lb. in double shear. Steel rivets will shear at 44,000 lb. per square inch of section in single shear, and at 77,000 lb. in double shear.

Shearing Resistanee of Rivets.

Size of rivet and hole.	Iron rivet, single shear.	Iron rivet, double shear.	Steel rivet, single shear	Steel rivet, double shear.
⅝ in. rivet, 11/16 in. hole...	14,105	24,683	16,332	28,581
11/16 in. rivet ¾ in. hole...	16,784	29,372	19,434	34,008
¾ in. rivet 13/16 in. hole..	19,703	34,478	22,814	39,923
13/16 in. rivet ⅞ in. hole...	22,849	42,091	26,457	46,300
⅞ in. rivet 15/16 in. hole...	26,227	45,895	30,368	53,144
15/16 in. rivet 1.0 in. hole...	29,845	52,228	34,557	60,474
1.0 in. rivet 1 1/16 in. hole...	33,668	58,919	38,984	68,222
1⅛ in. rivet 1 3/16 in. hole..	42,066	73,614	48,708	85,239
1¼ in. rivet 1 5/16 in. hole..	51,414	89,973	59,532	104,181



Double Shear. Single Shear.

In laying out boiler plate for riveted joints the size of the holes should be in proportion to the thickness and tensile strength of the plate, and the rivets spaced close enough to insure a tight joint when the work is complete.

Having decided upon the size of the rivet hole, the pitch of the rivets can readily be found.

Example: Suppose we have a plate ⅜-in. in thickness, 60,000 lb. tensile strength, and we wish to make a double-riveted joint with 13/16-in. iron rivets, driven in ⅞-in. rivet holes, we multiply the thickness of the plate by the tensile strength, and obtain the breaking strength of a strip of the plate 1 in. in width, thus $.375 \times 60{,}000 = 22{,}500$ lb. This result, divided

by 16, will give us the strength of a strip of the plate 1/16-in. in width.

By the foregoing table we find that one 13/16-in. rivet, driven in a ⅞-in. hole, will shear at 22,849 lb. (if in single shear), and two will shear at $22{,}849 \times 2 = 45{,}698$ lb. If the shearing resistance of the two rivets is 45,698 lb., and we have found the breaking strength of a strip of the sheet 1/16-in. in width to be $22{,}500 \div 16 = 1406$ lb., it will require as many sixteenths of the plate for the net section (plate between the edges of the holes), as the shearing resistance of the two rivets $42{,}091 \div 1406$, which is 30/16, or 1⅞-in. To this result must be added the diameter of the rivet hole (⅞-in.), and the centers then become 2⅞ in. We have now equalized the shearing resistance of the two rivets, and the breaking strength of the net section, and made as strong a joint as possible with that size rivet and plate.

The following table gives a very good proportion for single and double-riveted joints with good efficiency, and when properly made, tight work.

LAP JOINTS.

	Inches.	Inches.	Inches.	Inches.	Inches.
Thickness of plate...........	¼	5/16	⅜	7/16	½
Diameter of rivets...........	11/16	¾	13/16	15/16	1.0
Diameter of rivet hole	¾	13/16	⅞	1 0	1 1/16
Pitch single riveting..........	1 13/16	1⅞	1⅞	2 1/16	2 3/16
Pitch double riveting.........	2⅞	2⅞	2⅞	3¼	3¼
Strength of S. R. joint, per cent	58 6	56 0	53 3	51.5	51.4
Strength of D. R. joint, per cent	73 6	71 1	69 56	69 2	67.3
Distance between rows......	1 15/16	1 15/16	1 15/16	2 3/16	2 3/16

Table of proportions of boiler plate, having a tensile strength of from 50,000 to 60,000 lb., riveted with iron rivets in single shear.

Triple-Riveted Joints.

A lap-joint triple-riveted may have a higher efficiency than one double-riveted, as we have one more rivet to shear, the pitch can be increased, therefore giving more strength to the net section. In that style of joint the rivets will be in single shear, as shown in cut No. 3.

Example—Triple-riveted joint, steel plate, tensile strength per sq. in. of section = 60.000.

Thickness of plate ⅜-in. = decimal 0.375.

Area of 13/16 rivet hole = decimal 0.5185.

Pitch of rivets 3¼ in. = decimal 3.25.

Shearing resistance of iron rivets per sq. in. of section = 38,000 lb.

Then $3.25 \times 0.375 \times 60{,}000 = 731{,}125$ lb. strength of solid plate.

$(3.25 - 0.8125) \times 0.375 \times 60{,}000 = 54{,}843$ lb. strength of the net section.

$0.5185 \times 3 \times 38{,}000 = 59{,}109$ lb. strength of the three rivets in single shear.

The net section of the plate is the weakest, therefore; $54{,}843 \div 73{,}125 = 75$ per cent, efficiency of joint.

Double Welt Butt-Joint.

Joint No. 4, having four rows of rivets, the inside or center rows being in double shear, while the outside row (on each side), which is in double pitch, is in single shear.

A joint so designed will give two rivets in double shear and one in single shear, as the center row takes the sheet and both straps, while the outside row takes the sheet and inside strap only.

Example—Suppose the sheets to be ⅜-in. in thickness, 55,000 lb. tensile strength.

Rivet holes = 13/16-in., the center rows being pitched 2 3/16-in. (center to center of rivets), and the outside rows being pitched 4⅜-in., the problem would be as follows:

$4.375 \times 0.375 \times 55{,}000 = 90{,}234$ lb. strength of the solid plate.

$(4.375 - 0.8125) \times 0.375 \times 55{,}000 = 73{,}476$ lb. strength of net section.

Area of rivet hole = 0.5185.

Shearing resistance of two rivets in double shear = 68,956.

Shearing resistance of one rivet in single shear = 19,703.

$68{,}956 + 19{,}703 = 88{,}659$ lb., the shearing resistance of 3 rivets.

The net section is the weakest, therefore; $73{,}476 \div 90{,}234 = 81.4$ per cent as the efficiency of the joint.

Single Welt Lap-Joints.

These three styles of joints, largely used on locomotives designed to carry high pressures, or on boilers having jackets or covering hard to remove.

The principal advantage is that, being a lap-joint, there is but one calking edge to keep tight instead of two, as in the double welt butt-joint.

In these three joints the rivets are all in single shear; the strap should be as thick as the shell-plate.

In joints Nos. 5 and 7 the center rows of rivets are in single pitch, while the two outside rows are in double pitch. This should give an efficiency of 80 to 82 per cent, the strength of the solid plate.

In joint No. 6 the center rows are in single pitch, while the outside rows are one and one-half pitch; all four rivets in single shear. This will give an efficiency of 77 to 79 per cent the strength of the solid plate when the joint is well proportioned.

These joints are figured the same as joint No. 3, except we have more rivets to shear. In joint No. 5 we have five rivets in single shear. This will give an efficiency of 80 to 82 per cent.

In joint No. 7 we have seven rivets in single shear, with an efficiency of 85 to 87 per cent when properly proportioned.

Joint No. 8 is the usual type of double welt butt-strap joint used on large boilers, with heavy plate, especially for marine boilers.

In No. 8 the four center rows of rivets are in double shear; the two outside rows are in single shear.

In this type of joint we have four rivets in double shear and one in single shear. The center rows are in single pitch, while the outside rows are in double pitch. This should give an efficiency of 85 to 87.5 per cent the strength of the solid plate.

Joint No. 9 is of the same type, except that the inside strap is made wider, so that it will not only take a row of rivets in double pitch, but will also take an outside row in four pitch.

The effect of this is, as above explained, in reference to the triple-riveted joint. It increases the strength of the net section of the plate, so that when the straps are of sufficient thickness to make up for the loss drilled out of the shell-plates for rivet holes, it increases the efficiency of the joint to 93 or 94 per cent the strength of the solid plate.

[To be continued.]

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Prison Labor and Good Roads

The State of Montana for many years found it necessary to expend more money to maintain its criminals in enforced idleness than its legislators appropriated in sum total for the dispensing of a liberal education at the State University. This enforced idleness brought on largely by union labor agitators resulted in many instances in young men convicted of offenses not involving moral turpitude being compelled to associate with hardened and experienced offenders as cellmates.

A new condition of affairs is now, however, to be found in that great commonwealth. In our last issue we published details of costs in road building now actually being accomplished with prison labor in the construction of county highways. The new system by its life-inspiring hope to the prisoner is not only bringing about an enormous saving to the state but is best of all raising again to citizenship a lost band of men hitherto hopelessly drifting along without the slightest encouragement for them to ever again raise the head of self respect.

Albert J. Galen, attorney general of Montana, reports that without difficulty and with but comparatively few escapes, or attempted escapes, a crew of seventy-five prisoners can be successfully managed with three guards, who act more in the capacity of overseers of the work, than as guards. They are housed in tents at night, and their meals are served in a large mess tent. None of the guards are armed, and there is a very noticeable absence of cages, shackles, ball and chain, handcuffs and other such instruments of restraint. Of course the prisoners so trusted are furnished with clothing which does not brand them as prisoners, and this tends to preserve their self-respect; they are dressed in cadet blue suits, are furnished with better food and confidence is reposed in them as men. The results obtained by this honor system tends to give more confidence in human nature, and it is seldom that a prisoner disregards the confidence reposed in him. Instead of being despondent, morose and vindictive, the prisoner lives in hope, and on discharge is better fitted mentally and physically to again re-enter the struggle of life and work and live in accordance with the laws of society. Many states have attempted the employment of prisoners, but without the same satisfactory results. In some states, where prison labor is utilized for public road construction, the prisoners are forced to work under armed guards, held in restraint by manacles, and housed at night in portable cages, resembling very much such a wagon as is used in a circus for exhibiting ferocious animals. This system is necessarily expensive; and it is not surprising that the prisoners do not give the same satisfaction as under the Montana method.

The slogan of the day is "good roads for 1915." Every county and every state in the West fairly vibrates with agitation looking toward improvement in public thoroughfares. The Pacific Highway, conceived in audacious fancy so recently, is even now daily becoming a concrete reality. The experience in Montana is proving so economic and yet so life-giving and uplifting to that pitiful class known as

"fallen man," that our public leaders may well consider adopting this excellent system to all other sections of the West.

Western Water Rights and Legislation

In this issue of the Journal is concluded the widely discussed series of articles on Western water rights by A. E. Chandler, the well-known water right expert. Those of our readers who have closely followed the various discussions have been deeply impressed with one predominating feature; namely, a lack of uniformity of action in Western states in water right legislation. The statutes largely governing in water right decisions are based in the main upon the socalled "common law," and as the common law must be adapted to time and place, it is not to be wondered that different Western localities, varying in necessity for water supply, have developed widely differing procedure. Yet it is deplorable that uniformity and consistency does not exist. Some one has long since, in the anguish of his soul, said "Oh consistency, thou art a jewel," and truly would it be could Western water rights proudly boast this trait.

It has been clearly shown that hope for the future lies more in the liberality of the courts than by legislation. No longer is the doctrine of riparian rights tolerated in the thirsty West save in those states alone that may be classified as semi-arid in character. Even in these, however, it is glaringly apparent that the ultimate highest development demands utmost liberality in decision—a liberality in decision that would lead the courts of California, for instance, to disregard the time dishonored riparian doctrine and adhere to it only in such cases as would bring about manifest injustice should it be departed from. This liberality in decision should lead the courts to base their conclusion on what would constitute reasonable use and elimination of waste in the apportionment of the waters of a commonwealth and not leave the rights to this absolute Western necessity tied up to a piece of land simply because the decline of geologic ages happened to expose a path for erosion across a particular tract of land.

Indeed, highest use and greatest development, the lessening of the statutory period for laying claims to riparian rights, and a zealous display of public policy looking toward encouraging "first aid" to arid lands of the West would help wonderfully in the present entanglement. Oregon, Idaho and Wyoming seem at present to lead in highest development of water right legislation and evolution. In these states the practical control by a state officer—known as the state engineer, has evolved an efficient and ready means of water jurisdiction. The years of litigation incident to a successful and final determination of Western water rights have done much to discourage development in many localities of the West.

The Oregon law possesses three remarkable features that may well be emulated by other Western states. First, the data on existing rights is easily and impartially gathered by the state engineer. The gathering, of such data by the several biased parties to the issue is often the cause of more disputes and unjust delays and expense than any other feature of water right adjudication. Again, an equitable and firm hand is legally authorized to impartially distribute the adjudicated rights. Thus is secured in an efficient manner the consummation of the findings of the water commission and the decision of the court. And finally, an immense stride forward is taken by definitely maintaining the control of the acquisition of new water rights in the future.

In Colorado, when it is desired to appropriate water, publicity is given so that older owners of rights on the stream may have service and thereby be given ample time for just complaint. The new appropriator is consequently duly warned of troubles ahead before money is sunk in construction. Wise legislation, such as this, in other Western states would on many occasions have avoided years of costly litigation, and the wasting of much needed capital in growing communities of the West.

Another phase of the water right situation is comparable to the utility franchise. The past decade has seen endless strife in the wrangles of city councils and the street railway officials as to the capitalization of franchises. The issue seems now almost clean cut. Since the smoke of battle has cleared away, almost universally is it recognized that a franchise is a public trust and as such it becomes not the property of the utility company. Indeed, the latter day ideas of the franchise are so far divorced from ownership that the utility franchise is generally recognized as being the signet ring to pledge to the city that the utility company will "love, serve and obey" the mandates of the giver. On the other hand, the evolution of the indeterminate franchise brings new responsibilities upon the people and the municipality at large, which calls for a paternal protection and guarantee of fair play never before aroused in the public conscience.

So it will eventually be with the holder of hydroelectric water rights. The courts have ruled that the irrigation company supplying water to irrigable lands but not owning the land itself, has no ownership in the water rights but that these rights pertain to the land so supplied. The question of fixing a value to a hydroelectric water right is indeed perplexing and intricate. Many argue—and with convincing reasons—that no value should be attached to a power water right in determining rates for hydroelectric energy. It is urged that all such rights should be authorized as indeterminate licenses and thus control forever the direction of this gigantic unceasing natural resource.

There are many things to be considered in putting forth such assertions. To arrive at an equitable solution to the people at large an injustice almost bordering on confiscation will have to be done. In the ultimate solution, however, no one should lose sight of the fact that at least a liberal allowance should be made somewhere in the capitalized account, whether called value of water rights or not, for the brains, the originality, the audacity and the far-sighted constructive statesmanship of those who have developed in the West the world-beating triumphs of the hydroelectric industry.

PERSONALS.

E. E. Baker, secretary of the Mt. Whitney Power Company, of Visalia, is at San Francisco.

J. W. White, chief engineer of the Vix Engineering Company, is at Los Angeles on business.

Goodwin Trent, an engineer of Los Angeles, is a recent arrival at San Francisco from the South.

R. M. Alvord of the San Francisco office of the General Electric Company, expects to leave this week for a month's trip East.

S. L. Stovall, electrical and hydraulic engineer with the Mt. Whitney Power Company at Visalia, Cal., was at San Francisco this week.

Charles C. Hillis, general manager of the Electric Appliance Company, returned to San Francisco during the week after a business trip to the East.

Erwin Schwartzkopff, an electrical engineer of Berlin, has been visiting San Francisco and looking over the electric power plants in this vicinity during the past week.

Harry A. Storrs has recently associated himself with Edmund T. Perkins Engineering Company, First National Bank Building, Chicago, as consulting electrical engineer.

John B. Miller, president of the Southern California Edison Company of Los Angeles, recently arrived at San Francisco from his home at Pasadena, accompanied by his wife and daughter.

B. C. Carroll, general agent of the Pacific Telephone & Telegraph Company, accompanied the "Flying Legion" to Victoria, B. C., during the past week to "boost" for the Exposition of 1915.

W. B. Cline, president of the Los Angeles Gas & Electric Corporation, came up from the South, with Mrs. Cline and two daughters, who embarked at San Francisco for a trip to Manila on the steamer Manchuria.

R. J. Dinwoody has severed his connection with the Capital Electric Company of Salt Lake City, to join the sales department of the Inter-Mountain Electric Company, wholesale electrical jobbers in that city.

S. M. Sammis, chief engineer of the Marconi Wireless Telegraph Company recently returned to San Francisco after visiting the Hawaiian Islands in connection with negotiations for a site for a wireless plant at Honolulu.

A. W. Leonard, manager of the Minneapolis General Electric Company, has been prominently mentioned during the last few days as the possible successor of Richard T. Laffin, late vice-president of the Puget Sound Traction, Light & Power Company of Seattle.

E. G. Williams, J. G. White & Co.'s general manager of construction, is expected to arrive at San Francisco from New York during the coming week to look over the grading work that is being started on the Oakland, Antioch & Eastern Railway, which will be extended to Sacramento within six months.

Frederick S. Myrtle, the head of the Pacific Gas & Electric Company's publicity department, is visiting Victoria with the "Flying Legion" of San Francisco business men who left August 22d for British Columbia on a "boosting" excursion for the purpose of exciting interest in the Panama-Pacific International Exposition.

Wynn Meredith, of the firm of Sanderson & Porter, the consulting engineers for the General Pipe Line Company, during the past week accompanied Engineer **David Dorwood** on an inspection trip covering the work in progress on the 80-mile steel pipe line, which is to connect the wells of the Esperanza group with tidewater at San Pedro.

W. J. Lloyd of Chicago has been appointed general superintendent of the Mountain Division of the Western Union Telegraph Company, with headquarters at Denver. The territory under his jurisdiction includes Utah, New Mexico, Idaho, Montana, Wyoming, Colorado, Kansas and Nebraska. He entered the service of the company as a messenger at Dubuque, Ia.

OBITUARY.

Ralph Carter Peck, Pacific Coast lamp specialist for the General Electric Company, died at the home of his parents at Berkeley, August 25, after a lingering illness. He was a native of San Francisco and was 32 years of age and unmarried. He is survived by his parents, Mr. and Mrs. Edwin T. Peck, and a sister, Elizabeth T. Peck. The funeral services were held at the residence, August 27. Berkeley Lodge No. 1002, B. P. O. E., of which Mr. Peck was a member, was represented. As he was for a number of years connected with the General Electric Company the pall bearers were selected from his old associates in the service, including T. E. Bibbins, E. O. Shreve, F. D. Fagan, E. A. Hunt, W. V. Doughty and C. A. Loring.

Mr. Peck showed great ability during his long connection with the General Electric Company, with headquarters at the San Francisco office. He worked up from a clerical position in the order handling division to that of incandescent lamp specialist for the Pacific Coast, which he assumed in 1909. He has been greatly missed by his associates since illness compelled him to leave the office last April.

ELECTRICAL JOBBERS AT TAHOE.

As detailed in these columns last week the electrical supply jobbers of the Pacific Coast and their guests enjoyed a week-end outing at Lake Tahoe. Aside from the boating and fishing interest centered in the pool and bowling contests, H. E. Sanderson being the winner in the latter. The banquet on Saturday evening was attended by about thirty. J. A. Vandergrift acted as toastmaster. Albert H. Elliott spoke on the "Spirit of Lake Tahoe," H. V. Carter also responded in his customary able manner. W. L. Goodwin spoke on behalf of the jobbers, and T. E. Bibbins for the manufacturers.

ELECTRICAL LEAGUE OF SOUTHERN CALIFORNIA.

The Electrical League of Southern California was organized in January of this year as an outgrowth of the Electrical Lunch Club. The league now has an active membership of 121 and has accomplished much good in bringing harmony and co-operation into the electrical business. Among other new plans which are to be instituted when it reconvenes on September 3 is the establishment of a "suggestion box" from all members as to what the league can or should accomplish. A smoker and entertainment is to be given to the members on August 31.

JOVIAN CLUB OF SAN FRANCISCO.

An enthusiastic meeting of the Jovian Lunch Club of San Francisco was held at Tait's Cafe, August 27. The principal business was the adoption of the report of the temporary governing board of which R. M. Alvord had been made chairman, W. I. Otis, vice-chairman, and W. W. Hanscom, secretary and treasurer. On the committee on nominations to be presented at the annual meeting on September 3, Chairman Alvord named H. V. Carter, chairman; C. F. Butte, W. R. Dunbar, J. E. Vandegrift and M. E. Wise. The membership committee for the Rejuvenation on September 10, consists of A. H. Halloran, chairman; Louis Levy, W. L. Goodwin, W. W. Briggs, G. E. Holberton and A. W. Bullard. The next meeting will be held at 12:15, September 3, at Tait's cafe.

ENGINEERS' CLUB MEETING.

The engineers' club of San Francisco was interestingly addressed last Tuesday noon at the Palace Hotel by Director Smith of the Philippine Bureau of Mines. Mr. Smith particularly pointed out many of the engineering difficulties met with in the Philippine Islands and not encountered in this country.

ARNOLD TO REPORT ON SACRAMENTO RAILWAYS.

Bion J. Arnold, the eminent traffic expert, has been engaged by the Pacific Gas & Electric Company to make a complete investigation of their electric street railway system at Sacramento, California. His report will include every detail of construction, operation and maintenance except the valuation, which has already been made by J. G. White & Co.

TRADE NOTES.

The Stewart-Fuller Company has been awarded the conduit contract for the new Geary Street Municipal road at San Francisco.

The Southern Pacific Company, West Oakland, Cal., has ordered from the Westinghouse Electric & Manufacturing Company one 300 kva., 3 phase, 4000 volt, 62½ cycle synchronous condenser.

The Caldwell Traction Company, Caldwell, Idaho, has recently ordered from the Westinghouse Electric & Manufacturing Company one quadruple equipment of No. 306 motors with K-35-G control.

The Westinghouse Electric & Manufacturing Company has recently received an order from the Ewbank Power Transmission & Motor Company of Portland, Ore., for one quadruple equipment of No. 304-A railway motors.

The Westinghouse Electric & Manufacturing Company has received an order from the Pacific Electric Railway Company, Los Angeles, Cal., for thirteen type No. 267-E line switch equipments for use as contactors with quadruple 125 h.p. motors and L-4 controllers.

The Triumph Electric Company of Cincinnati announces through its San Francisco agent, Mr. G. A. Wilbur, the sale of two 75 kw., d.c., engine type, 3 wire generators, to the California Hydraulic Engineering & Supply Company. These generators are to be installed in the Spalding Building at Portland.

Sacramento has finally abolished the flat rate for electric current, being the first town of any size in California south of the lines of the Northern California Power Company to adopt meters. The General Electric Company has received an order from the Pacific Gas & Electric Company for about 9000 meters, which will be rapidly installed. Many of the houses are also being rewired.

John S. Baker, Pacific Coast district manager for the Crocker-Wheeler Company, announces the sale of a quantity of electric apparatus to the Southern Sierras Power Company for installation at Plant No. 3. The specifications call for the following: Three 2250 kva., 300 r.p.m., 60 cycle, 3 phase, 2200 v., water wheel driven generators. Also one motor-generator exciter set, one 100 kw. water wheel driven exciter set, and complete switchboard controlling main generators and exciters. The generators will be direct-connected to three water wheels designed by George J. Henry Jr., and will have solid poles, which particularly adapts them for operation in parallel over long distances such as will be necessary in operating to San Bernardino.

NEW CATALOGUES.

There has just been issued by the General Electric Company an attractively bound book of 132 pages, Bulletin No. 4958, devoted to the use of the "higher voltages" in the operation of Direct Current Electric Railways. It contains numerous tables comparing the various costs of 1200 volt systems as compared with those of 600 volts. Bulletin No. 4978 illustrates various installations of electrically driven pumps used for irrigating purposes and contains charts giving comparative crop yields of irrigated and unirrigated lands. Bulletin No. 4932 is devoted to the application of Electricity in the Brewing Industry. Bulletin No. 4976 is devoted to Electric Drive in grain elevators and flour mills, and supersedes the company's bulletin on this subject.

NEWS OF CALIFORNIA STATE ELECTRICAL ASSOCIATION.

The Butte Electric & Engineering Company have been awarded the wiring for St. Ignatius church for the sum of $8300.

Some months ago a committee from the Electrical Contractors' Association, called on the board of works and attempted to show them that it was to the advantage of the city to finish the city hospitals by contract instead of by day labor, as it was being done by the former administration. The city architect at that time advised against same. But the architectural commission have advised differently and the result is that the hospital is being finished by contract. One large contract has been let to the Butte Electric & Engineering Company for the signal system, and on September 11 bids will be received for the balance of the work.

The contractors at their Saturday meetings are holding a series of talks on methods of handling material for jobs. Each speaker shows the blanks that he uses in his own business.

Russ Wolden, of the California Electric & Construction Company, gave the first talk on August 17th. C. F. Butte followed him on August 2. As each member is anxious to improve his methods a great deal of good is expected from this interchange of ideas.

It is the intention of the contractors to thoroughly discuss every system that is brought to their attention, thus allowing the members to get the best from each. As soon as this subject is gone over a new subject will be taken up.

A committee will take the good points from all systems and recommend same to the next State convention for a standard.

The contractors have changed their regular daily lunch place from Campi's to room 12 at Jules', at 12:15 sharp. Visiting contractors are always welcome.

Regular weekly meeting at Jules' at 12:30 sharp, every Saturday. Meetings adjourn at 2 p.m., sharp, as we have some baseball fans who never miss a Saturday game.

Among the large wiring contracts being figured are: Shreve's warehouse and factory, at Bryant and Thirteenth streets. Two hotel buildings, on Mission and Fourth streets. St. Francis church, Vallejo and Columbus avenue. Clift Hotel, Geary and Taylor streets. Apartment house, Larkin and Turk streets. Annex to Argonaut Hotel, Fourth and Jessie streets. Hotel building, north side of Mission street, between Fifth and Sixth streets. A fine residence for James Flood, Vallejo and Webster streets. It is reported that plans for the Regents Hotel on Sutter street have been abandoned and that Architect Polk has been ordered to get out plans for an office building. The above building is a very good illustration of the expense that a contractor can be put to, with no chance of receiving a penny for his labor, in order that an owner can make up his mind how he can best invest his money.

There has been spent by the electrical contractors on this one building alone, in its three previous trips on the market, about $2500. An amount equal to about 20 per cent of the amount of the lowest bid. When you multiply this amount by 10, being the number of different trades that have been asked to make up these estimates it can easily be seen where a great deal of money is wasted in unnecessary figuring.

It appears to the writer that the Board of Regents of our State University should be able to put up a building without all this unnecessary waste of other people's money. It looks as if a Board of Control is needed on the other side.

If any one that ordered photographs at the Contractors' convention and did not receive same, will notify W. S. Hanbridge at 1408 Merchants' National Bank Bldg., same will be investigated.

INDUSTRIAL

FREQUENCY METERS.

Frequency meters are extremely useful switchboard appliances, as they indicate immediately any variation in the speed of prime movers. By their use, irregularities in the operation of engine or waterwheel governors may be readily detected and immediately brought to the attention of the operator so that adjustments can be made. On circuits that supply induction motors driving textile mill and other machinery requiring constant speed, constant frequency is essential, and the installation of a frequency meter will constantly indicate the speed being maintained. In the central station supplying power and lighting service, the maintenance of normal frequency is equally important. Many watthour meters now on the market are adjusted for a particular frequency and register slow if the frequency is either below or above normal. A meter that will indicate a variation from normal frequency, therefore, tends to prevent this loss of revenue.

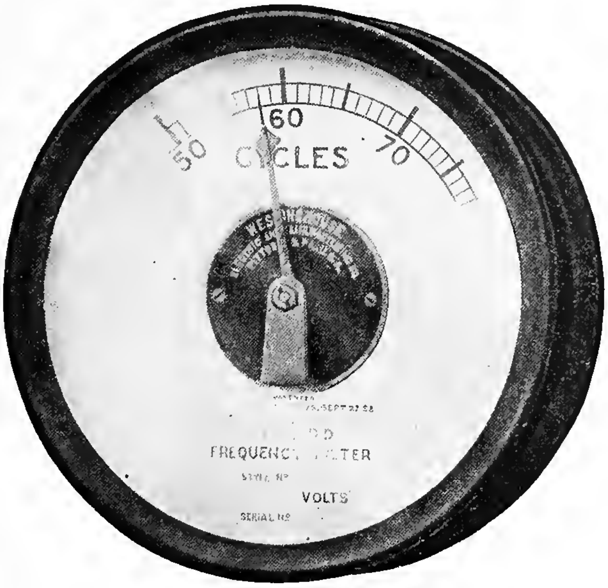

Fig. 1. Nine-Inch Frequency Meter.

The Westinghouse frequency meters, two new types of which are here illustrated, indicate the frequency accurately by means of a continuous scale and pointer.

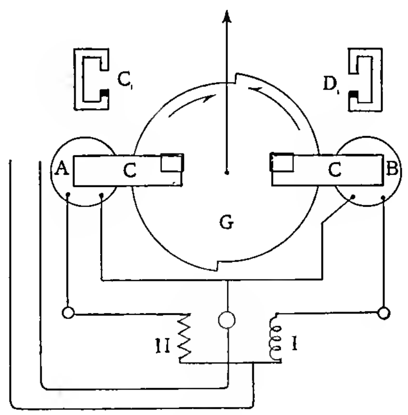

Fig. 3.

The meter consists of two induction voltmeter elements, A and B, Fig. 3, acting on a disk, G, and tending to move the disk (and the pointer shaft) in opposite directions. One of the elements is in series with a resistor H and the other in series with a reactor I, so that any change in the frequency tends to change the relative strength of the two magnets and cause rotation. The disk is so shaped that, as it moves, the amount of its metal under the strongest magnet becomes less than that under the weaker magnet, so that with every relation between the two magnet strengths there is some point where the torques produced by the two magnets balance and the pointer comes to rest. Magnet A tends to turn the disk in clockwise direction, and magnet B in the opposite direction.

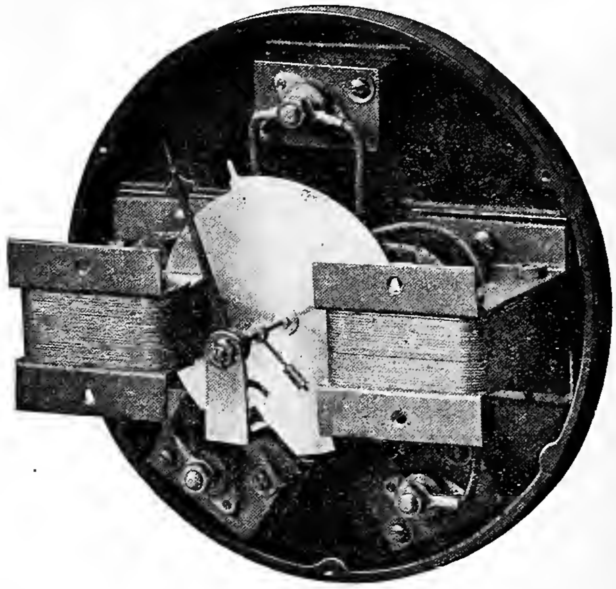
Fig. 2. Parts of Frequency Meter.

The torque of each magnet is proportional to the square of the current in the coil and to the frequency. At normal frequency, the torques balance when the disk is in the middle position. If the frequency increases, the current in coil A, which is in series with resistance only, remains unchanged and its torque increases because of the higher frequency; the current in coil B, which is in series with reactance, diminishes and its torque diminishes correspondingly. The disk, therefore, turns toward the right. For similar reasons, if the frequency decreases, the disk turns toward the left.

If the periphery of the disk were a true circle, any change in frequency which would cause the torques of the two magnets to be unequal would produce continuous rotation in one or the other direction. The disk is, therefore, made of a special shape. The left-hand edge of the disk, which moves under magnet A, is practically the arc of a circle, having its center at the shaft. The right-hand edge, which moves under magnet B, is practically the arc of a circle with its center slightly above the shaft. With this arrangement, the amount of metal in the air gap of A is always practically the same, while the amount of metal in the air gap of B depends on the position of the disk. When magnet B becomes relatively stronger than A, owing to low frequency, the disk turns toward the left and the amount of metal in the air gap of B, and consequently the torque of B, gradually decrease until the torques of the two magnets balance, when the disk stops. When magnet B becomes relatively weaker than A, owing to high frequency, the disk turns toward the right, and the amount of metal in the air gap of B and consequently the torque of B gradually increase until the torques of the two magnets balance, when the disk stops. For every frequency there is a definite point at which the disk comes to rest.

As actually constructed, the edges of the disk are not true circular arcs. The shape is determined experimentally, so that a uniform scale will result. ..

NEWS NOTES

INCORPORATIONS.

PORTLAND, ORE.—Articles of incorporation have been filed for the Hurley Hydraulic Power Transmission Company. Incorporators: W. J. Binns of San Francisco, and J. H. Hurley and Alexander Sweek of Portland. Capital $50,000.

OLYMPIA, WASH.—With the total capitalization of $1,500,000 and naming as its object the building of an interurban line from Seattle to Tacoma and then to Olympia, articles of incorporation of the Seattle-Tacoma-Oympia Railway Company has been filed. Seattle is named as the principal place of business. Either electrical power, compressed air or steam may be used in operating. The trustees are: W. D. Hall, J. S. Wheeler and S. L. Cravens of Seattle.

ILLUMINATION.

SUMPTER, ORE.—The electric light plant of the Northwestern Light & Power Company was recently destroyed by fire. Loss approximately, $10,000.

VENICE, CAL.—The Pneumatic Power Company, with offices in the Security Building, Los Angeles, has applied for a 50-year franchise to install a water, gas and electric light plant in Venice.

SAN RAFAEL, CAL.—Sealed bids will be received up to September 5th, for the installation and maintenace of poles, wires and other accessories for a street lighting system for the Fairfax lighting district.

BUTTE, MONT.—The Chamber of Commerce, this city, approves the plan of the City Council for providing a lighting system and has pledged its support. Approximately 366 lights, costing $37,175, will be installed.

VAN NUYS, CAL.—By vote the citizens have decided to form the Van Nuys Highway Lighting District. One plan suggested contemplates the erection of ornamental poles with clustered lights throughout the entire 16 miles of boulevard.

PALO ALTO, CAL.—Bids for the concrete building for the water and light plant here, recently received, were: C. A. Bates, San Jose, $15,785; J. M. White Co., San Francisco, $25,500; R. O. Summers, San Jose, $27,699; Bluxome & Co., San Francisco, $28,500. White & Co. presented two alternative propositions— one with modification of the truss roof for $25,250, and one with portion of the walls to be constructed of brick, $24,000.

NEWPORT, CAL.—An election has been called for September 10 for the purpose of submitting the question of incurring bonded indebtedness for acquisition and construction of municipal light works. The proposition is to incur $25,000 bonded indebtedness for the acquisition and construction of generators, retainers and holders for creating and storing electrical energy and necessary buildings, also a distribution system. Bonds to the amount of $39,000 are to be issued for the acquisition and construction of generators, holders, for making, generating and storing illuminating gas and necessary buildings and all necessary distributing systems, consisting of pipes and conduits and all other machinery.

TRANSMISSION.

SAN BERNARDINO, CAL.—According to reports the Southern Sierra Power Company is to add a third unit to its great electrical plant in this city.

SUMPTER, ORE.—The Eastern Oregon Light & Power Company of Baker is at present establishing a power line into this city for the purpose of furnishing power to the Powder River dredge being built here.

ALVISO, CAL.—Work has begun on the $25,000 sub-power station which is to be located some three miles from this city. The Sierra & San Francisco Light & Power Company has material on the ground for the 24 big steel towers.

NAPAVINE, WASH.—The Independent Electric Company has asked the Lewis County Commissioners for a franchise to operate a power line through this place. The old line on the military road in the southern part of the county is to be changed to the C. E. Leonard road to supply Winyock, Little Falls and Castlerock with current.

BAKERSFIELD CAL.—Whether or not the Standard will will pipe its gas to San Francisco Bay is the question that some are asking. The big company has millions and millions of cubic feet in Buena Vista Hills and throughout the Midway District and a great deal more can be obtained through surrounding properties. The Midway Gas Company that is to supply Los Angeles with gas, is buying from the Honolulu Consolidated and also seeking wells for itself. The Standard's gas is still free and the amount used in Bakersfield is insignificant.

TRANSPORTATION.

SALEM, ORE.—Work of clearing the right of way for the electric road from here to Stayton will commence in a few days. The road will be 20 miles long.

RIALTO, CAL.—Bids will be received up to October 1 for a franchise granting right to construct a double track street and interurban railway for a period of 50 years through the city of Rialto.

INDEPENDENCE, ORE.—An electric line is to be built from this place to Buena Vista, work to be begun at once. H. Hirschberg, president of the Independent & Monmouth Railroad, is authority for the statement.

SPOKANE, WASH.—J. H. Young, president, is authority for the information that the Spokane & Inland Empire Railway, will soon construct an extension of the line from Millwood to Newman Lake, Idaho. Surveys are being made.

VANCOUVER, WASH.—Work will begin on the Sifton-Hockinson extension of the Washington-Oregon Interurban line and it is expected to be completed long before the allotted time, January 1, 1913. Lotter & Company are the engineers.

GLENDALE, CAL.—The Glendale & Verdugo Park Railway Company will soon begin active operations, all stock having been subscribed and the money necessary having been paid in. Engineers are now engaged in the preliminary work.

SANTA BARBARA, CAL.—W. H. Brackenridge, vice-president of the Southern California Edison Company, and H. W. Dennis, chief construction engineer of the company, are going over plans for the construction of a street railway in this city.

TACOMA, WASH.—Plans for a municipally owned street car line and bridge across the new Eleventh street bridge, running from A street to River street and Puyallup aveuue, and with possibly a branch across the Puyallup river, are being discussed here.

MODESTO, CAL.—The board of directors of the Modesto-Empire Traction Company have decided to purchase a locomotive to haul the road's rapidly growing freight shipments. The directors are also planning to equip the road with electric storage battery cars.

LEWISTON, IDAHO.—The Nez Perce & Idaho Railroad Company, of Nez Perce, will commence surveys at once across the Craig mountains from Forest to Waha and through the Tammany section to Lewiston in preparation for the electric railroad which is to be built.

LOS ANGELES, CAL.—At a recent meeting of the executive committee of Good Government Organization, it was resolved that the city build a double three-rail street car track on San Pedro street, from Aliso to Sixth, for immediate relief of the congestion of street railway traffic.

WILMINGTON, CAL.—The Pacific Electric is rushing construction on the big grade along the water front and will soon have it completed so that trains can run around the bay. South of this grade the Wilmington Transfer Company is building a bulkhead to hold the dredged material.

CLE ELUM, WASH.—S. R. Justham, superintendent of the Salmon Le Sac project of the Kittitas Electric Railway & Power Company, is the authority for the statement that actual work on the line that is to connect this city and Roslyn will be begun within less than a week. According to his statements $15,000 will be expended and a force of 1000 men be given employment.

LOS ANGELES, CAL.—A conference was held recently between a delegation of property owners and W. E. Dunn, managing director of the Los Angeles Railway Company, relative to the proposed car line in South Main street, between Thirty-sixth Place and Slauson avenue. The property owners agree to pay the company's share of paving the street if the company puts in the car line.

SAN FRANCISCO CAL.—Action looking to the immediate extension of the Geary street municipal road from Kearny street down Market to Sansome, where it is to be connected with the outer Market street tracks to provide for a through service to the ferry station, has been taken by the Supervisors. On recommendation of the public utilities committee, the board approved plans and specifications prepared by the Board of Works for the Market street extension and ordered the Board of Works to advertise immediately for bids.

LOS ANGELES, CAL.—At the request of representatives of the Municipal League the Council deferred action one week on the ordinance granting the Pacific Electric Company a 21-year permit to haul freight over its lines in the industrial district east of Los Angeles street. Attorney J. A. Anderson, who appeared as spokesman for the committee representing the Municipal League, said that action should be deferred so that all possible light might be thrown upon the provision of the proposed ordinance. He maintained that the city should be given the power to re-route the cars and maintained that the ordinance should contain an indeterminate provision as to the life of the permit. Councilman Reed said that the freight carrying permit was worth half a million dollars.

TELEPHONE AND TELEGRAPH.

ARLINGTON, WASH.—The Chamber of Commerce is promoting a farmers' telephone line from here to Darrington.

CUTBANK, MONT.—A move has been started for the establishment of a rural telephone system here, to go into the more populated districts.

ST. MARIES, IDAHO.—St. Maries is to have a new telephone exchange costing $9000. J. W. Fisher, manager of the Interstate Telephone Company, has completed plans for the work.

WATTS, CAL.—Bids will be received up to September 17th for a franchise granting the right to operate for 21 years a telephone and telegraph system along the highways of this city.

ILO, IDAHO.—The Pacific States Telephone Company has planned to invest $2000 in Ilo in a modern and up-to-date plant. The improvements include a copper circuit direct to Lewiston.

GLENDORA, CAL.—Sealed bids will be received up to September 3 for a franchise granting the right to maintain for 50 years poles and wires for carrying on a general telephone and telegraph business in this city.

PRESCOTT, ARIZ.—The acquisition of the Overland Company by the Mountain States Telephone Company, will, when connections are made, greatly increase the scope of telephonic service. In Arizona connections will be made with Flagstaff, Holbrook and Winslow.

SEATTLE, WASH.—The county equalization board has refused to reduce the assessment of the Pacific Telephone & Telegraph Company on account of the revocation of the franchise of the Independent company by the City Council, shortly after the two companies were merged. The Pacific company has been assessed $2,471,000 on its tangible property and franchises, and asked that this be reduced to $2,211,182. The Pacific franchise alone was valued last year at $282,615. The combined franchises were valued this year at $459,818. The Pacific company contends that when the Independent plant was taken over last spring the value of the Independent franchise ceased to exist.

EDMONTON, ALBERTA.—Official announcement was made by W. H. Harmer, deputy minister of railways and telephones for the province of Alberta, at Edmonton on August 9 that the government telephone construction program, including the stringing of more than 1500 miles of main lines and the installation of several thousand instruments, will be completed before the end of the year. Twelve hundred men are at work in the various districts. The new copper circuit between Edmonton and Calgary, 198 miles, will be completed early in September and the department will be in a position to handle the business between the two cities for several years to come. Three direct circuits will be in use between Edmonton and Calgary, two of these being copper circuits and the third a "phantom" circuit, formed by the combination of the other two lines. The new circuit from Edmonton to Athabasca Landing, 90 miles, is nearing completion and before fall is far advanced the new service will be in use. The line from Edmonton to Tofield, 40 miles; has been completed. The Tofield-Viking circuit, 41 miles, also is in operation. Other lines which will greatly improve the service between the large and small towns of northern Alberta are being rapidly rushed forward. Lines will be finished this season between Camrose and Tofield, 41 miles; between Camrose and Vegreville, 47 miles; between Camrose and Sedgewick, 44 miles. From Hardisty to Provost, 47 miles; and new lines from Castor to Coronation, 22 miles; are under construction. The line from Castor to Stettler, 34 miles, is completed. Circuits are being installed along the Vegreville-Calgary branch of the Canadian Northern Railway, 180 miles, and along the Tofield-Calgary branch of the Grand Trunk Pacific Railway, 198 miles. The new construction extends from Camrose to Calgary by way of Stettler, 156 miles, along the right of way of the Canadian Northern road, and from Camrose to Calgary, 151 miles, along the Grand Trunk Pacific road. On the main line of the Grand Trunk Pacific, east of Edmonton, local circuits are being installed to relieve the traffic on the main circuit. These local services will give telephone connection between Kinsella and Wainwright, 42 miles, and between Tofield and Viking, 42 miles. Circuits are being installed from Calgary south to High River, 49 miles; from Calgary to Cochrane, 42 miles, and from Calgary to Medicine Hat, 175 miles. The copper circuit between Calgary and Medicine Hat will be completed and in operation in September. Other lines are being built to take care of local business between Calgary and Bassano, 75 miles, and Bassano and Brooks, 42 miles. The lines from Calgary to Carstairs, 40 miles, from Calgary to Red Deer, 95 miles, from Calgary to Airdrie, 41 miles and from Calgary to Acme, 43 miles, will be ready before the end of the year. The new line from Carmangay to Lethbridge, 87 miles, was opened recently, giving a second circuit between the two points. On the Crow's Nest line in the Rockies a number of new circuits, to take care of local business, are under construction and will be completed this season.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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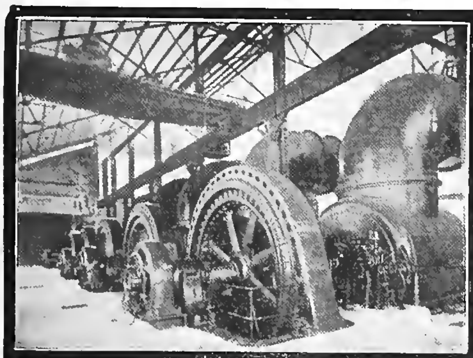

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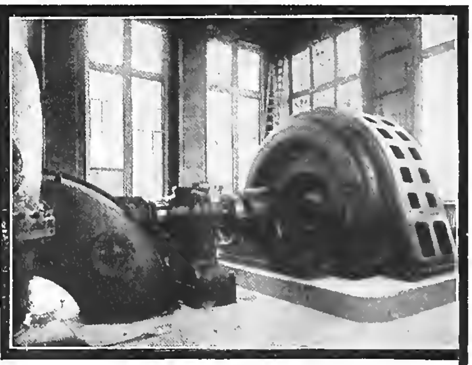

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JOURNAL OF ELECTRICITY
POWER AND GAS
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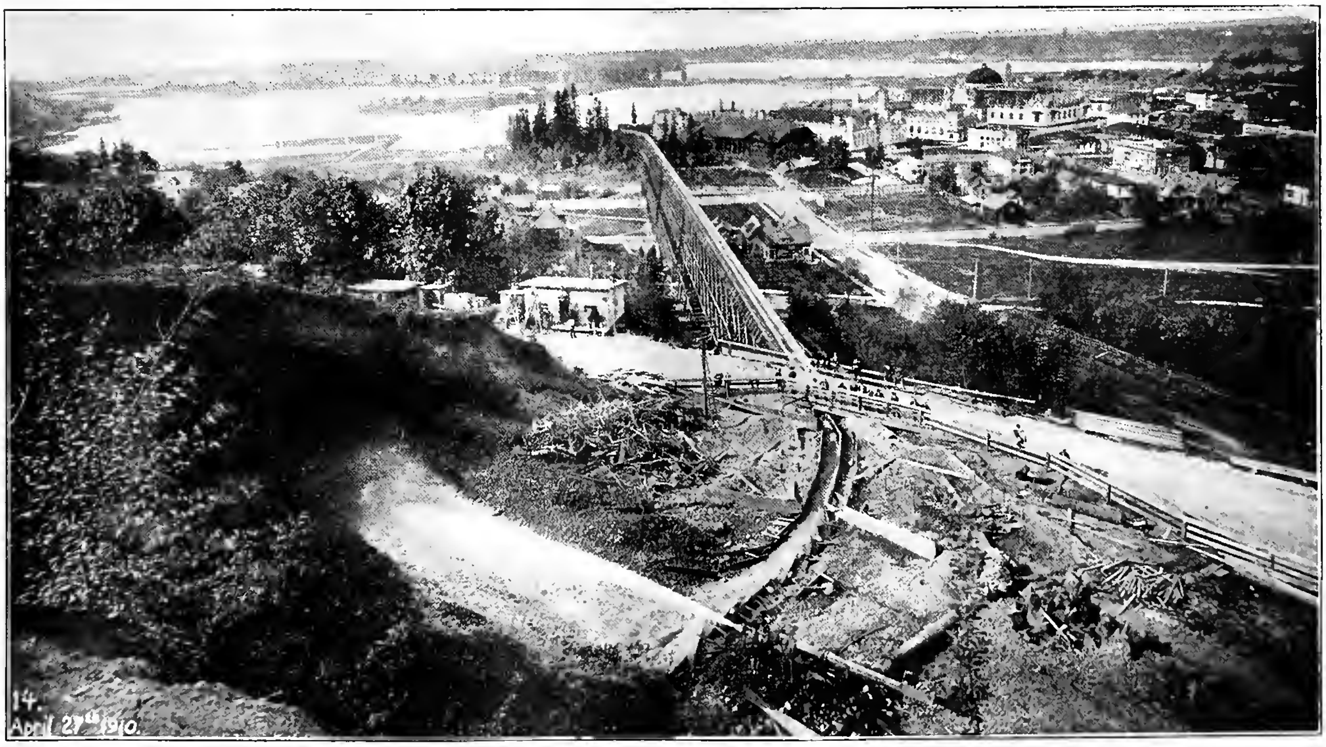
VOLUME XXIX | SAN FRANCISCO, SEPTEMBER 7, 1912 | NUMBER 10

THE SEATTLE AND PORTLAND HYDRAULIC WORK

Among the great engineering accomplishments of the Northwest, probably the greatest, in point of the benefits derived by a municipality, are the large regrading operations in Seattle and Portland.

The City of Seattle is built between the shores of Puget Sound on the west and Lake Washington on the east, the distance between the two being about two miles in the narrowest place. In the north central part of the city Lake Union, and still farther north Green Lake, two fresh bodies of water with a combined area of 1000 acres, are located. The topography of the townsite consists of a series of glacial moraines rising to an elevation of from 300 to 400 ft. and running in a general northerly and southerly direction. In its original state the business district was confined almost entirely to one or two streets along the waterfront of the eastern shore of Elliott Bay, and to a small level section adjoining the tideflat area to the south of the business center.



Hydraulicking at Guild's Lake, Portland.

Owing to this peculiar situation and the consequent spreading of the population over a large area (the land area of Seattle is about 58 square miles, and the water area 36 square miles, making a total of 94 square miles in the corporate limits), vast excavation projects have been necessary in order to create additional area for business purposes and to make possible the access by easy gradients from the outlying districts to the business center, thereby avoiding long detours around the prohibitive grades.

The Local Improvement District Method of making improvements was adopted by the citizens of Seattle in 1892. Under the terms of this ordinance the various regrading projects are brought about in the following manner:

A petition for the work is circulated among the property owners in the district to be improved. When the signatures of 75 per cent of the interested owners have been secured favoring the work, the petition is presented to the city council for action. After being favorably passed upon by the council the city engineer is directed to lay out the improvement district, establish new grades on the streets affected, draw plans and make an estimate of the probable cost of the work. A board of eminent domain then determines the amount of damages or benefits accruing to the various ownerships. Property which is found to be damaged by the improvement is relieved of the payment of assessments, and the amount of the damages determined is included as part of the total cost of the work. Assessment roll maps are then prepared showing the assessments on each lot to cover the cost of the work. The assessment district often covers more area than the actual improvement district on account of benefits derived to adjacent property.

Bonds are issued by the city to pay the cost of the improvement. These bonds usually pay 6 per cent or 7 per cent interest, run for a term of from five to ten years, according to the size of the contract, and are secured by a first lien on the property in the district. The owners then have the privilege of paying their assessments into the city treasurer's office in cash, or in annual installments during the bond period.

The bond issue covers only the work done in city streets, private contracts being made between the contractor and property owners for the excavation on the lots.

In Seattle three districts have been improved by the hydraulic method of excavation, namely, the Jackson Street, et al., and the Dearborn Street, et al., districts in the southern portion of the city, and the Third Avenue, et al., commonly known as the Denny Hill district in the northern end of town. These districts are in addition to the large number of contracts in which the excavation has been done by steam shovel and cars.

In the Jackson Street contract, which was the first large contract to be let, a total of 5.8 miles of streets were improved and 56 square blocks of property were regraded, 29 of which required to be excavated and 27 of which were filled. Original grades of from 6 per cent to 18 per cent here were reduced to a maximum grade of 7 per cent and some-as low as 1 per cent. Cuts ranged from 10 ft. to 94 ft., and fills as high as 45 ft., and a total of 3,347,000 cubic yards were excavated.

The unit prices for earthwork on this job were 10 cents a cubic yard for excavation and 15 cents per cubic yard for embankment, with an allowance of 15 per cent in the embankment for shrinkage. The total cost of this job was about $915,000.

Immediately after the completion of this contract, traffic which far years had taken a course a mile out of its way on account of the impassable grades on Jackson street, naturally came through this new outlet, with the result that delivery charges on building materials, fuel and supplies, were materially reduced to a vast area of outlying territory between the business center and Lake Washington. The contract was completed in December, 1910, and is already well built up with substantial business houses, whereas before the improvement it was nothing but a cheap residence and rooming house quarter.

Lewis & Wiley, Inc., the contractors for this work, installed a pumping plant on Elliott Bay for their water supply. The plant consisted of four 10 in. 5 stage Worthington centrifugal pumps direct connected in units of two pumps each to two 650 h.p Worthington motors. The capacity of these pumps was 12,000,000 gallons per 24 hours under 375 ft. head. The supply line to the work consisted of about 6100 ft. of 24 in. machine banded wood stave pipe. The working pressure at the giants was about 75 lb. per sq. in. An additional supply of 6,000,000 gallons per 24 hours was obtained from a steam pumping plant on Lake Washington, which the contractors leased from the city water department. This plant pumped directly into a reservoir on Beacon Hill having a capacity of 3,850,000 gallons, and the water was used from this reservoir under a gravity head of about 180 ft.

The material was transported to the dump, in some cases a mile from the point of excavation, in wood stave pipe lines from 20 in. to 22 in. in diameter. This pipe was reinforced on the bottom with wood blocks placed with the grain up to increase the life of the pipe.

In the portion of the Jackson Street contract which required filling, the streets were raised on pile trestles and the buildings were jacked up to the new grades and set on posts. In this way business went on without interruption while fills were being made beneath them in some cases 45 ft. deep.

The contract for the Dearborn Street district, which was awarded in August, 1909, called for the improvement of about 3.2 miles of streets, and 10 square blocks of private property. The principal object of this work was the opening of a new artery from the business center of town to the populous Rainier Valley and the southern end of Lake Washington. Grades of from 15 per cent to 18 per cent here were reduced to a maximum of 3 per cent, and a total of 2,169,542 cubic yards were excavated, of which about 125,000 cubic yards were removed by steam shovel.

The contract price on this contract was 20 cents a cubic yard for material excavated and placed in embankment.

From the surplus excavation in the combined Jackson and Dearborn Street jobs, 85 acres of tidelands in the south end of town were raised to an elevation above high tide and made available for building improvements. The approximate total cost of this work was $557,000.

The material excavated in the Dearborn and Jackson Street contracts consisted of a hard blue clay strata of glacial origin, with an overburden of about 12 ft. of soft yellow clay. This material in places was so compact and hard that it required continual blasting to loosen and break it up. From 250 to 400 lb. of powder were used daily in charges of from 2 to 3 lb. each.

In the Third Avenue, et al., district the excava-

tion was handled in the same manner as in the above mentioned work, with the exception that the material was transported in a box flume (instead of stave pipe) and was all wasted in Elliott Bay, the fill being kept at an elevation of 40 ft. below low tide.

A total of 2½ miles of streets and 21 square blocks were excavated here, with cuts ranging from 10 to 112 ft. and a total of 5,098,952 cubic yards of earth was moved at a unit price of 27 cents per cubic yard, making the total cost of this improvement $1,376,717.

Summary of Hydraulic Work.

11½ miles of streets improved.
10,616,377 cubic yards excavated.
Total cost, $2,850,000.

R. H. Thomson, formerly city engineer of Seattle, states in his annual report to the council for the year ending November 30, 1910, that up to that time there had been moved in local improvement work a total of 14,936,251 cubic yards. Since that time the excavation in the three contracts mentioned has amounted to 1,850,000 yards, and together with the excavation by steam shovel and other sources the total to date would probably approximate 18,000,000 cubic yards.

At the date of this report the total cost of local improvement work, which does not include expenditures on account of water supply, was $31,331,109. The total at the present time will probably reach $35,000,000.

The following facts, compiled by the publicity department of the Seattle Chamber of Commerce, with regard to what is known as the Jackson Street project are of interest. This regrade involved an area of 128 acres practically in the heart of the city. The work, in its essential features, was done in one year and a half, employing an average of 200 men and running three shifts for 24 hours a day. On this particular job not one serious accident to any of the workmen occurred. The quantity of earth removed was 3,500,000 cubic yards; the maximum cut was 100 ft. and the excavations varied from zero to maximum. The transformation of the streets in this district may be understood when it is realized that on some of the important thoroughfares the grades have been changed from impassable to 3 per cent. Not long ago the contractors stationed a man, between the hours of 7 a. m. and 4 p. m., at one of the inter-sections which had not been available for teaming because of the steep grade. During those hours an average of 1 78-100 teams per minute passed that point. Since then the district has rapidly built up so that traffic is even greater. In the sluicing operations on this particular contract 24,000,000 gallons of water per day were utilized, one half of which was salt, pumped from the bay by an electric power pumping station, and one-half fresh, being the surplus taken from the city water system. The contractors realized 10 cents per yard for cutting away the hill and 15 cents per yard for filling in the tide-flats and raising the elevation of other low ground wherever they were able to dispose of the dirt.

Various Views of Work Accomplished at Seattle.

Another one of the contracts, that for the removal of Denny Hill, which is more striking in the contrasts it affords between the old and the new than the Jackson Street, involved the removal of 6,000,000 yards with a maximum excavation of 130 ft. and an average of from 60 to 70 ft., 30,000,000 gallons of water were used for the sluicing work on this hill, while

General Layout of Hydraulic Work at Portland.

steam shovels and small dirt trains were also utilized. Some of the views will give an idea of the regrade of Third avenue. Similar work has been done on Fourth avenue. Third avenue, for instance, when it was widened in connection with the regrade, required the cutting back of the fronts of several buildings already on that thoroughfare. The New York building (a brick building) having a frontage of five stories on Third avenue, had a section taken out of the "L" and the main portion of the building fronting on Third avenue was moved back more than seven feet so as to obviate the necessity of reconstructing the front.

The Seattle Athletic Club building, at Fourth and Cherry streets (a brick and stone building of several stories) was kept at the same elevation above sea level, but had two stories built underneath in order to conform with the lowering of the street grades surrounding it.

Portland Work.

Actuated by their success in the sluicing operations in Seattle the Lewis-Wiley Hydraulic Company purchased, in 1909, several adjoining tracts of land in the City of Portland, with the idea of improving it by the same methods.

The total project covers an area of 142 acres, 65 acres of which lie on an abrupt hill on the west side of the city, rising to an elevation of 650 ft. above the city, surrounded by the best residence districts and commanding a wonderful panoramic view of the city and the Willamette and Columbia River valleys. One parcel of 40 acres lie in Guilds Lake, an overflow of the Willamette River, and the balance of 36 acres comprise a deep gulch running back from the lake and just west of the 65-acre tract. The general plan is to reduce the hill tract by the hydraulic method, and improve it as a first-class residence district of about 400 lots. The excavation is transported in a timber flume about 2500 ft. long, and is being used to fill up a part of the gulch and the 40-acre lake tract. The property is virtually being made to order. Every lot will be a view site, and the streets and boulevards will have a maximum grade of 8 per cent.

The work has been in progress since April, 1910, and at the present times is about 65 per cent complete, 1,989,000 cubic yards having been excavated out of a total of 3,210,000 cubic yards.

The contractors are using the same pumping plant on this work which they had in Seattle, with the addition of a two stage 16 in. Worthington pump direct connected to a 900 h.p. Westinghouse motor. This additional pump unit is necessary on account of the added head over that for which the Seattle plant was designed. The pumps are now delivering about 8,000,000 gallons per 24 hours against a head of 675 ft.

Work is carried on continuously 24 hours per day, and about 100,000 cubic yards per month are being moved. At this rate the project will be completed in about twelve months.

The total project will represent an outlay of about $1,350,000, including the cost of the property, excavation, and street improvements.

SALARIES OF TECHNICAL GRADUATES.

The following statistics have been compiled from recent returns from the graduates of the Massachusetts Institute of Technology, classes of 1907 and 1908. Although the returns for each class are not complete, the average annual salary of 106 members of the class of 1907 was $2028, the lowest being $600 and the highest $6000. The replies received from 139 members of the class of 1908, showed an average annual salary of $1796 per annum, the lowest being $520 and the highest $5200.

THE USE OF SMALL PUMPING PLANTS FOR IRRIGATION IN BRITISH COLUMBIA.

BY B. A. ETCHEVERRY.

While British Columbia is favored with a system of large rivers such as the Thompson, the Fraser, the Kettle Valley and lakes such as the Okanagan, these splendid large bodies of water are practically not available for gravity irrigation because of the topography of the irrigable land. The irrigable land exists usually in separate small valleys formed on both sides of smaller streams, or in small benches high above the rivers or lakes, generally with considerable slope towards these bodies of water. This position of the irrigable land combined with the flat grade of the rivers makes diversion by gravity flow directly from these sources an economical impossibility. These conditions have made it necessary to utilize the smaller streams or creeks, the flow of which is irregular, being abundant at the beginning of the irrigation season but in many cases decreasing to an insufficient volume before the close of the season. Most of the watersheds of these streams are favored with reservoir sites which can be utilized at a moderate cost to regulate the flow. Up to the present the natural stream flow, supplemented in some cases with storage water, has been the usual source of supply. Naturally the systems most easily constructed were installed first and the best available sources have been taken up. With the increasing demand for water to put new land under irrigation, less favorable sources of water supply must be utilized and the cost of development will become greater. There will still remain bodies of land for which no gravity water is available or only available at a very high cost, and which may be situated at a moderate elevation above the large rivers or lakes. For these conditions the development of a water supply by pumping may be the best solution. The information given below applies to small pumping plants, irrigating from about 10 to 100 acres.

Considerations Controlling the Selection of a Pumping Plant.

The proper selection of a pumping plant depends upon many factors which should be carefully considered by the intending purchasers. These factors are: (1) capacity of plant and period of operation, (2) the kind of pump, (3) the class of engine or driving power, (4) the first cost, (5) fuel cost, (6) cost of fixed charges and attendance. These factors are interdependent and should be considered together. Their relative importance will vary with local conditions and for that reason it is not possible to state definite rules which will apply in all cases. A study of the conditions affecting each factor is therefore necessary in each case.

Capacity of Plant and Period of Operation.

The required capacity of the plant will depend on the area irrigated, the duty of water or depth of water required on the land and the period of operation. For ordinary orchard soil in the arid part of British Columbia a total depth of 12 in. of water during the irrigation season will be sufficient for young orchards. For a full bearing orchard 18 in. should be ample, while for alfalfa and other forage crops 24 to 36 in. is plenty. Where the cost of pumping is high, such as for small plants and high lifts, it will usually not be feasible to grow at a profit anything but orchards. To reduce the cost of pumping, no excess water should be used, all losses should be prevented by careful irrigation and thorough cultivation, in which case a young orchard on fairly deep retentive soil may not require more than 6 to 9 in. of irrigation water and a full bearing orchard not more than 12 or 15 in. during the irrigation season. To put a depth of 2 ft. of water on one acre, it takes a flow of very nearly 1 cu. ft. per second for 24 hours; this is equivalent to 450 U. S. gallons per minute for 24 hours. This relation can be applied to any case to obtain the size of the pump. For example, if it is desired to irrigate a 40 acre orchard 1½ ft. deep, in an irrigation season of 120 days, this requires 60 acre ft. in 120 days, or ½ of an acre ft. per day. This will be obtained by a pump giving ¼ of a cu. ft. per second, or 110 U. S. gal. per minute, when the pump is operated continuously 24 hours a day every day during the irrigation season of four months. For a 10 acre orchard the required capacity based on the same conditions would be ¼ the above or 28 gallons per minute or 1-16 of a cu. ft. per second, or about 2¼ British Columbia miners' inches.

The above two examples are based on a pump operating continuously at the rates given above. While continuous operation decreases the required size of plant, it is usually preferable to select a plant of larger capacity and operate it only a part of the time. This is especially desirable for very small orchards in which case continuous operation gives a stream too small to irrigate with. The other disadvantages of continuous operation are:

1st. Continuous operation requires continuous irrigation and constant attention to operate the pumping plant. For very small tracts a regulating reservoir may be used, but it must be of considerable capacity to be of any service and it must be lined with concrete to prevent seepage losses of the water which when pumped is too valuable to lose. Usually it is preferable to purchase a larger plant and do without a reservoir.

2d. Continuous operation means that the water can not be applied to the different parts of the orchard within a short time, so that only a small part of the orchard or farm receives the water when most needed, and the remainder must be irrigated either too early or too late.

3d. Continuous operation gives a small stream which can not be applied economically.

4th. A small plant is less efficient and requires a proportionately larger fuel consumption than a larger plant to pump the same quantity of water.

On the other hand a very short period of operation requires a comparatively large pumping plant which will greatly increase the first cost of installation, the interest on the capital invested, the depreciation and fund necessary to provide for renewal.

Usually it is desirable to operate the pump not over ½ or 1-3 of the time during the irrigation season and often a shorter period is desirable. This requires a pumping plant two or three times or more the size required for continuous irrigation. The capacity of the pump must be sufficient in all cases to give a large enough stream to irrigate economically; even for the

smallest orchards a stream of at least 5 miners' inches or about 63 U. S. gallons per minute, is desirable.

For a full bearing orchard 18 in. of irrigation water applied in about three irrigations of 6 in. each at intervals of 30 to 40 days should be ample in most cases. As stated above, where the water has to be pumped to a high elevation the higher cost of the water demands great care in its use and 12 to 15 in. total depth of irrigation water would be sufficient.

The table below gives the required pump capacity for various sizes of orchards or farms and for different periods of operation. It is based on a depth of irrigation water of 6 in. each month, or 18 in. in 3 months, which is taken as the irrigation season. The period of operation is given in number of 24 hour days that the pumping plant is operated each month. These days need not be consecutive; for instance if the operation period is 10 days, instead of applying 6 in. of water in one irrigation lasting 10 days, the soil may be so porous and gravelly that it will not retain moisture, in which case it may be preferable to apply 3 in. at a time in two irrigations during the month, of 5 days each. The required pump capacity is given in U. S. gallons per minute of Imperial gallons because the pumps sold in British Columbia are mostly rated in U. S. gallons per minute.

Necessary Capacity of Pumps in U. S. Gallons Per Minute to Give a 6-Inch Depth of Water on the Land Each Month When Operated the Following Number of 24 Hour Days Per Month.

Area Acres.	30 days.	20 days.	15 days.	10 days.	5 days.	2½ days.	1 day.
5	19	28	38	56	113	225	563
10	37.5	56.25	75	112.5	225	450	1125
15	57	85	113	170	340	675	1690
20	75	113	150	225	450	900	2250
30	113	169	225	338	675	1350	3375
40	150	225	300	450	900	1800	4500
60	226	338	450	675	1350	2700	6750
80	300	450	600	900	1800	3600	9000
120	450	675	900	1350	2700	5400	13500

The capacity of pumps for smaller or greater depths of water applied per month can be easily computed by proportion from the values given. For different areas and different periods of operation the capicity may be obtained by interpolation.

Kind of Pump.

The kinds of pump commonly used to raise water for irigation are (1) centrifugal pumps, (2) power plunger pumps, (3) deep well pumps, (4) air lift pumps, (5) hydraulic rams.

Deep well pumps and air lift pumps are used for pumping underground water from deep wells. In British Columbia the underground water supply is unknown and need not be considered at present when the water supply is obtainable from the large streams and lakes adjacent to irrigable area. For pumping from these sources the centrifugal pumps and the power plunger pumps are the best adapted. Hydraulic rams are used for small quantities of water such as for domestic purposes or for irrigation of small pieces of land. They are economical in operation, but require special conditions such as a nearby stream with sufficient fall in a short distance. The choice between a centrifugal pump and a power plunger pump will depend on the capacity required and the height of lift.

Centrifugal Pump.

A centrifugal pump consists of a circular casing with the inlet or suction end connected to the center and the outlet or discharge end formed tangent to the perimeter. Inside the casing is the runner or impeller keyed on the shaft and revolving with it. It is formed of curved vanes closely fitting the casing and corresponds to the piston or plunger of a plunger pump. When in operation the impeller by revolving imparts a velocity to the water between the vanes and forces it away from the center of the casing towards the perimeter or rim of the casing through the outlet and up the discharge pipe. This produces a partial vacuum at the center of the impeller which induces a flow through the suction pipe into the casing. The number of revolutions of the runner or speed of the pump has an exact relation to the head or lift against which the pump is working and for every head there is a speed for which the pump works most efficiently. This speed can be obtained from the pump manufacturers. It is important that the pump be connected to an engine or motor which will give it the proper speed. Overspeeding is preferable to underspeeding but either reduce the pump efficiency.

Simple centrifugal pumps specially designed and driven at a sufficiently high rate of speed may be used for lifts considerably over 100 ft., but usually the stock pump obtainable from the manufacturers is not suitable for lifts over 75 ft. and for the smaller sizes the total lift should not exceed 50 ft. For higher lifts compound or multi-stage centrifugal pumps are used. These consist of two or more pumps connected in series, the discharge of the first pump or stage is delivered into the suction of the next pump and the operation is repeated according to the number of stages. Usually 75 ft. to 125 ft. is allowed to each stage.

Where the required capacity of the pump is over 100 or 150 gallons per minute and the total lift less than 75 ft., the centrifugal pump is no doubt the best adapted.

Centrifugal pumps are usually denoted by a number which represents the diameter of the discharge in inches. The efficient capacity of each size will vary to some extent with the speed of the pump which depends on the total lift pumped against. The pumps can, therefore, not be rated accurately. The capacities given in the accompanying table are worked out from the ratings given by a reliable pump manufacturer and are subject to considerable variations either above or below the values given.

No. of pump or diameter of discharge in inches.	Capacity in U. S. gallons per minute.	Capacity in second feet or acre inches per hour.	Capacity in British Columbia miners' inches.	Number of acres irrigated, 6 in. deep each month for operation period, during the month, of 30 days.	20 days.	15 days.	10 days.	5 days.	2½ days.	1 day.
2	100	.22	8	27	18	13	9	4½	2¼	9-10
2½	150	.33	12	40	27	20	13	6½	3¼	1 3-10
3	225	.50	18	60	40	30	20	10	5	2
3½	300	.66	24	80	53	40	27	13	6½	2 2-3
4	400	.90	32	110	71	55	36	18	9	3 2-3
5	700	1.60	57	190	127	95	63	32	16	6 1-3
6	900	2.00	71	240	160	120	80	40	20	8
7	1200	2.70	95	320	213	160	107	54	27	10 2-3
8	1600	3.50	125	430	287	215	143	72	36	14 1-3

To start a centrifugal pump the suction pipe and the pump must be filled with water or primed. This may be done by closing the discharge pipe with a check valve and connecting the suction end of a hand pump to the top of the casing. Where a steam engine is used a steam ejector may take the place of the hand

pump. For small pumps and low lifts a foot valve on the end of the suction pipe may be used and the pump primed by pouring water in the casing, or suction pipe. The disadvantage of a foot valve is that if the water is not clear a small stone or twig may lodge itself in the foot valve and prevent priming. This will necessitate that the suction pipe be uncoupled and the obstruction removed.

The pump must be placed as near as possible to the water level to keep the suction lift down. While theoretically the suction lift may be as great as 33 ft. at sea level and about 30 ft. at an elevation of 3000 ft., it is desirable not to exceed 20 ft. and less is preferable.

The plant efficiency can be increased by reducing the friction in the suction and discharge pipes. As few bends as possible should be used and these should be made by using long turn elbows. The suction and discharge pipes should be larger than the intake and outlet openings of the pumps and joined to the pump with an increaser. The diameter of the suction pipe and especially of the discharge pipe should be 1½ times the diameter of the intake and if the discharge pipe is long it may be economy to make its diameter even larger. Enlarging the lower end of the suction pipe will further decrease the friction. This may be done by a funnel-shaped section whose length is about 3 times the diameter of the suction pipe and whose large end is about 1½ times the diameter of the pipe. The larger opening at the entrance to the suction pipe will decrease the tendency to suck up sand or gravel. When the water carries weeds, gravel, or other material a strainer should be used and the total area of the strainer should be at least twice the area of the suction pipe. The discharge pipe should not carry the water any higher than necessary.

Choice Between Centrifugal Pump and Power Plunger Pump.

The choice between a power pump and a centrifugal pump will depend on the lift and capacity.

In irrigation work power pumps are best adapted to high heads above 75 ft. and to small or moderate volumes of water, usually under 200 gallons per minute. For these conditions the efficiency of a power pump is usually greater than that of a centrifugal pump. For greater volumes the plunger pumps are comparatively expensive and centrifugal pumps are usually preferable unless the lift is excessive. The centrifugal pump has the advantage that it is simple in construction with no parts to get out of order, and that it is cheaper than a power pump. The selection should be made only after careful consideration of the first cost of the pump and the annual cost of fuel, operation and maintenance. Where the lift is high the fuel cost will be considerable and it is good economy not to select the cheapest pump obtainable but one that is guaranteed for a high efficiency. On the other hand if the pump is only to be operated a very small portion of the season it would be poor economy to invest a large capital in a high grade pump to save in fuel cost.

Capacity of Engine.

The power necessary to lift water is indicated in horsepowers. A horsepower represents the energy required to lift 33,000 lb. 1 foot high in one minute; this is equivalent to 3960 gallons of water per minute raised 1 foot high. This relation enables one to find the horsepower required in any case by multiplying the discharge of the pump in gallons per minute by the total lift in feet and dividing by 3960. The result obtained represents the useful water horsepower necessary to lift the water. The horsepower delivered by the engine to the belt or gears when the pump is belted or geared to the engine, or to the pump itself when direct connected, is the brake horsepower and must be greater than the useful horsepower to allow for the loss of energy in the pump and transmission. The horsepower developed within the engine itself is the indicated horsepower and must be greater than the brake horsepower to allow for the energy loss in the engine itself. Gasoline engines and motors are rated on brake horsepower. Steam engines are rated on indicated horsepower.

The combined efficiency of a pumping plant represents the ratio of the useful water horsepower to the rated horsepower of the engine, and will vary considerably with the type of pump, method of connection of engine with pump and the care taken in operating both pump and engine at the proper speed. In ordinary field practice a good pumping plant, properly installed, should easily reach the efficiency given in the following table:

Efficiency of Centrifugal Pumping Plants.

No. of centrifugal pump.	Discharge in U. S Gallons per minute.	Water horsepower per foot of lift.	Efficiency.	Brake horsepower per foot of lift.
2	100	.025	30 per cent	.081
2½	150	.038	35	.11
3	225	.057	40	.14
3½	300	.08	45	.18
4	400	.10	45	.22
5	700	.17	50	.34
6	900	.23	50	.46
7	1200	.31	50	.62
8	1600	.41	55	.75

ELECTRIC TRAMWAY CONSTRUCTION AND EQUIPMENT IN COSTA RICA.

The Official Gazette of Costa Rica, of July 4, invites tenders for a concession for constructing and working for 50 years an electric tramway between Alajuela and Grecia, with a branch line to San Pedro de Poas, a total length of about 16¾ miles. The estimated cost of constructing the tramway is placed at 1,076,800 colons ($500,712). The estimated cost of a hydroelectric power plant on the Poas River for working the tramway is placed at 655,803 colons ($304,-948). All material required for construction and equipment of the undertaking may be imported free of duty, and the Government guarantees interest from date of opening of tramway to public service for a period of 25 years at 6 per cent per annum on capital invested up to a total of 1,000,000 colons ($465,000).

Further particulars and plans may be obtained from the Direccion General de Obras Publicas, San Jose, at a cost of 25 colons ($11.63) per set. The Purdy Engineering Company, of San Jose, which made the preliminary surveys, would also probably be prepared to supply plans, but it is not known what its charge would be.

THE FACTOR OF SAFETY.

As Called for by the United States Tables of Steam Pressure on Steam Boilers.

REVISED BY J. B. WARNER.

[Concluded.]

Single Welt Lap Joints.

This style of joint is used on large wood pulp digesters, and other work where there are but few fittings and high pressures are necessary.

It is necessary to have well-proportioned joints, if the boilers are to run at as high pressures as are calculated in the table of pressures published by the U. S. Treasury Department

The factor for safety is low, being only 4 2/10 for new and perfectly proportioned joints.

The question is often asked, Why is it necessary to make the longitudinal seams so much stronger than the transverse or girth seams?

The reason is, that the strain on the longitudinal seams is twice that of the transverse seams.

In some types of boilers it is more than twice, for in the Return Tubular, or a boiler having tubes and stays from head to head, they relieve the transverse seams, while the longitudinal seams have the full load to carry.

On the transverse, or girth seams, the pressure would be; the area of the head being .7854 × (square of the diameter), the total pressure upon it would be:

$$.7854 \times (\text{diameter})^2 \times \text{pressure}.$$

This pressure acts endwise along the boiler, tending to pull it apart; and it is withstood by the plates of the boiler, and where these come together at the girth seams, the length of each girth seam is the same as the circumference of the boiler; that is, it is equal to

$$\frac{.7854 \times (\text{diameter})^2 \times \text{pressure}}{3.1416 \times \text{diameter}.}$$

Since 3.1416 is exactly 4 times .7854, we find, from the above calculation, that the strain on the girth seam per in. of its length, is:

$$\frac{\text{diameter} \times \text{pressure}}{4}$$

We thus see that the strain on the girth seam of a boiler is just half the strain on the longitudinal seam, so that if the former is half of the strength of the latter, the two are equally well adapted to the loads they have to carry when the boiler is in operation.

In a boiler with a longitudinal seam having a strength of 85 per cent of the solid plate, the girth seam will be as strong in proportion if only 42½ per cent of the strength of the solid plate, whereas, a well-proportioned single-riveted joint is 56 to 58 per cent.

On all water tube boilers the safety factor should be 5. On lap joints a pressure of over 165 lb. should not be allowed. Standard tubes should not be allowed over 175 lb. pressure. If more pressure is desired, heavier tubes should be put in. Blow-off pipes over blow-off pipes should be used in preference to a larger size.

Packing-Rings.

Packing-rings for pistons are turned to a diameter one-eighth inch larger than the cylinder for every foot in diameter of the cylinder. This is necessary in order that they may spring out and fill the cylinder, a piece being afterward cut out of the ring to make it the proper size. The ring is cut in an oblique direction in order to prevent the ends or joints from scoring the cylinder. The length of piece required to be cut out of the ring is equal to the difference between the external circumference of the ring and the circumference of the cylinder.

Example—A packing-ring for a piston is 60⅝ in. in external diameter before being cut. The diameter of the cylinder is 60 inches. How much should be cut out of the circumference of the ring to make it eactly fit the cylinder when sprung in?

$60.625 - 60 = .625.$

$.625 \times 3.1416 = 1.96$ in.; the amount to be cut out.

SUMMARY OF CONCLUSIONS ON OIL-MIXED PORTLAND CEMENT CONCRETE.

The following conclusions as to the effect of the oils used in cement and concrete may be drawn from the recent investigations of the U. S. Office of Public Roads.

(1) The tensile strength of 1:3 oil-mixed mortar is very little different from that of plain mortar, and shows a substantial gain in strength at 28 days and 6 months over that at 7 days.

(2) The times of initial and final set are delayed by the addition of oil; 5 per cent of oil increases the time of initial set by 50 per cent and the time of final set by 47 per cent.

(3) The crushing strength of mortar and concrete is decreased by the addition of oil to the mix. Concrete with 10 per cent of oil has 75 per cent of the strength of plain concrete at 28 days. At the age of 1 year the crushing strength of 1:3 mortar suffers but little with the addition of oil in amounts up to 10 per cent.

(4) The toughness or resistance to impact is but slightly affected by the addition of oil in amounts up to about 10 per cent.

(5) The stiffness of oil-mixed concrete appears to be but little different from that of plain concrete.

(6) Elasticity.—Results of tests for permanent deformation indicate that no definite law is followed by oil-mixed concrete.

(7) Absorption.—Oil-mixed mortar and concrete containing 10 per cent of oil have very little absorption and under low pressures both are waterproof.

(8) Permeability.—Oil-mixed mortar containing 10 per cent of oil is absolutely water-tight under pressures as high as 40 lb. per sq. in. Tests indicate that oil-mixed mortar is effective as a waterproofing agent under low pressures when plastered on either side of porous concrete.

(9) The bond tests show the inadvisability of using plain bar reinforcement with oil-concrete mixtures. The bond of deformed bars is not seriously weakened by the addition of oil in amounts up to 10 per cent.

Note.—A public patent has been granted for mixing oil with Portland cement concrete and hydraulic cements giving an alkaline reaction, and therefore anyone is at liberty to use this process without the payment of royalties.

SAN FRANCISCO TRANSPORTATION PROBLEM.

Preliminary Report No. 7.—Part 1.—Improvements in Rolling Stock.

BY BION J. ARNOLD.

[Concluded.]

For a Future Standard Car.

(14) Over-all width 8 ft. 6 in., track centers not less than 10 ft. 2 in., (sidewalk width 12 ft. on 68 ft. 9 in. street), giving two-line vehicle traffic on all streets.

Note.—It is understood that the United Railroads now has in contemplation the following modifications of the original plans:

(1) Moving front exit gate next to bulkhead.
(2) Cleveland's arrangement of fare box and guide rail.
(3) Cross seat cushions 17 in. x 34 in.
(4) Bulkhead posts to be flared back to increase shoulder width at entrance.
(5) Sliding or folding step.
(6) Storm curtains, if satisfactory on Geary Street cars.
(7) Ventilating intakes if found necessary.
(8) Removal of fare box from entrance way.
(9) Vertical stanchions in closed compartment set out to knee line.
(10) Platforms to be tapered, when improved type of fender is developed.

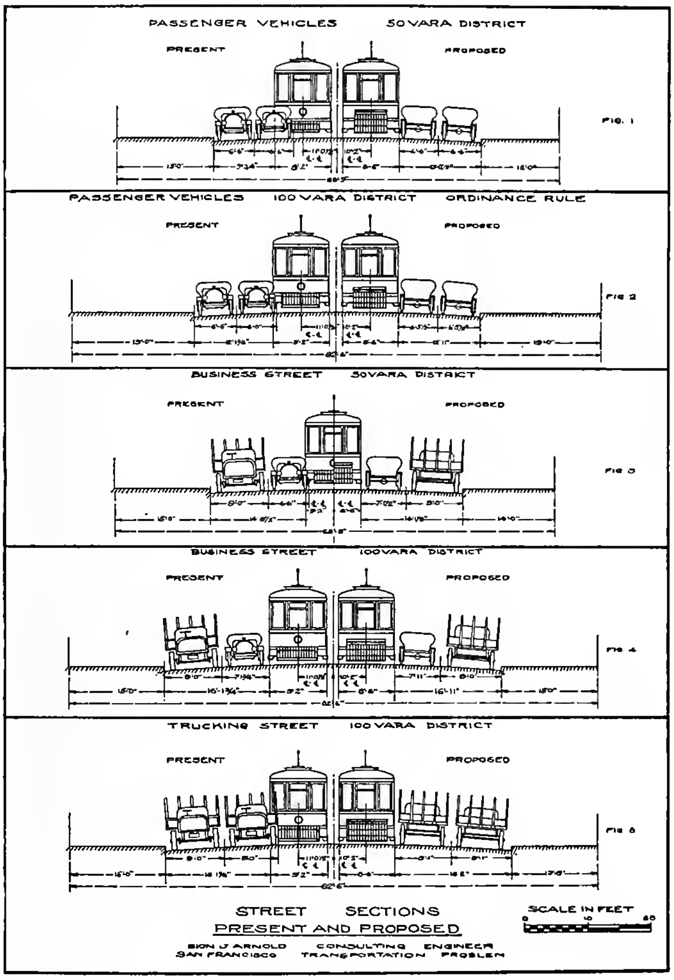
Discussion.

Seating Arrangement: In the Geary Street cars I have preferred to locate the principal storage space in the open section, while the reverse is true in the United Railroads design. My reason for so doing is in recognition of the fact, which I have determined by observation, that the average passenger rides less than two miles along a given route before alighting. This means that the shorthaul passengers greatly predominates, and consequently that extra space must be provided for persons disinclined to move forward because of a short trip ahead.

On the other hand, the United Railroads provides this extra storage space by using longitudinal seats in the closed section to encourage people to move forward in order to clear[1] the rear part of the car for new-comers, and also for the reason that during stormy weather, longitudinal seats will accommodate the maximum number of persons desiring to be protected. However, the United Railroads design provides no sash in the open sections, nor storm-curtains as does the Geary Street car. It is possible that the storm-curtains for the latter may not prove a perfect appliance for this purpose, but in the absence of something better I certainly should not consider it wise to spoil such a good seating arrangement as in the Geary Street cars on account of a short period of inclement weather.

One method that occurs to me of encouraging passengers to move forward is to limit smoking, by ordinance, to the front open section, thereby inviting forward a fair proportion of the passengers immediately after entrance. The serious objection to the United Railroads layout is that the passengers entering the car body are immediately forced into the center of the aisle, counter-current to those passing out through the rear exit. On the other hand, the side seat plan as used in the Geary Street car provides not only a relatively wide passageway, but also an offset aisle which will tend to separate lines of entering from leaving passengers.

Experience in other cities tends to show that longitudinal seats do not attract street car patrons—cross seats, quite the reverse. Consequently, the advisability of thus using all longitudinal seats in the center or closed section is very doubtful, especially with so wide a car as here proposed. The fact that riding in San Francisco is extremely short-haul justifies the use of a certain percentage of longitudinal seats; but they should be placed where most needed, and in this respect the Geary Street car design is in my judgment the more desirable for the present car. The best that can be said of the United Railroads seating arrangement is that it is a con-



Diagrams of Street Sections.

Present and Proposed Arrangements Compared in Each Diagram.

1. Standard street, 50-Vara—Western Addition district. Two car lines and passenger vehicles only. With present 15-foot sidewalks, only one line of vehicle traffic possible. With narrower car (i.e., 8 ft. 6 in.), and sidewalk reduced to 12 ft., two lines of traffic are possible. This condition impossible with wider car.
2. 100-Vara—Mission District; with standard ordinance width of sidewalk—19 ft.—two-line passenger vehicle traffic possible only with narrower car. In this district, however, the sidewalks have been reduced by special ordinance on most of the important streets.
3. Business street, 50-Vara District. Two car lines barely permit single line traffic for freight vehicles. But with single car track, two-line traffic can be secured by reducing the sidewalk width to 14 ft. Two-line mixed traffic impossible with either car and present standard width of sidewalk. 12-ft. sidewalk, as proposed in 1, would permit two-line freight vehicle traffic with narrower car, but hardly with wider car.
4. Business street, 100-Vara District, showing actual sidewalks. Two line mixed traffic possible with either narrow or wide car. Nine inches greater margin or clearance with narrower car. This shows most efficient utilization of 9 ft. 2 in. car in the district where wide streets occur, such as Mission Street, as referred to in conclusion of this report.
5. Heavy trucking street, 100-Vara District. Sidewalk 15 ft. in width, as established by ordinance, does not permit two-line vehicle traffic with double-track car line. By reducing sidewalk to the usual standard—one-sixth of street width—two-line vehicle traffic is possible with narrow car, but not with wide car. This condition typical of Howard Street, which has been set aside for heavy trucking through the Mission. Using the present standard track centers—11 ft. ½ in.—two-line heavy vehicle traffic can only be secured by cutting sidewalk to 13 ft. 7 in. for the narrower car, or 13 ft. 3 in. for the wider car.

siderable improvement over some of the present equipment, with the exception of the so-called Chicago car, which may be identified by class numbers 1500 to 1549, and the half cross, half longitudinal seat type, represented by class numbers 1550 to 1749. In the latter, the longitudinal seats run as far

[1]As a matter of fact, the contraction of the aisle at the ends instead of the center tends to defeat the very purpose in view by checking free forward movement right at the entrance.

as the center of the car on the one side, then for the remainder of its length on the other side, thus approximating the Geary Street arrangement except for the central closed section.

Width of Car. As a result of experience and observation in Chicago during the complete rehabilitation of the transit system, it would seem that the adherence to a car as wide as 9 ft. 2 in.[2] in San Francisco is a mistake, provided that a future standard is under discussion. If all of the streets of your city were of the generous proportions of those of the business district south of Market Street, the necessity for limiting the car width would not arise. Unfortunately, however, the streets of the 50-Vara district and Western Addition are, as a general rule, only about 68 ft. 9 in. in width. And, still more unfortunately, the track centers have been standardized at a distance of 11 ft. ½ in. in order to secure an ample width of "devil strip"—22½ in. between cars. This width undoubtedly represents good practice, although a width of 20 in. is sometimes sufficient where street widths are limited. Unfortunately, again, the sidewalks in the 50-Vara district and Western Addition are fixed by ordinance at 15 ft. in width, which is too great to permit two-line vehicle traffic on each side of the street. In order to secure reasonably rapid transit, two-line vehicle, traffic is absolutely essential, to enable slow-moving vehicles to keep next to the curb, rapid vehicles passing between them and the car. If the usual proportion in sidewalk width were in vogue, viz.: one-sixth of the width between building lines, the sidewalk would be approximately 11½ ft. wide. Then with the narrower car—8½ ft. in width—and a 20-inch "devil strip," there would be ample room for two lines of vehicles on either side. Under present conditions two-line traffic is impossible, as a 15 ft. sidewalk only permits a single line of vehicles. Therefore, at the present time, the wider car will offer practically no greater obstruction to street traffic than the narrower car, in the Western Addition District.

It is entirely possible, however, that future steps may be taken to reduce the width of sidewalks in order to clear some of these streets. And in addition, considering the new streets which will be improved and electrified from time to time, it is not too early to establish a standard which will make these things possible. Narrowing of the track centers in order to require less of the roadway width than at the present time must be effected to carry out this plan. This can only be done gradually on extension and rehabilitation work, but ultimately the entire city will be brought to one standard.

For an 8 ft. 6 in. car, 10 ft. 2 in. track centers may be used, as is the present standard within the City of Chicago. This combination makes available 18 in, more of roadway than under present conditions. The desire of the United Railroads to furnish the maximum width of aisle by using the wider car is indeed laudable, but when it is considered that the wider car is obtained at the expense of narrowing the roadway, I cannot recommend it, especially when a width of aisle, 28 in. between seat backs, has proven sufficient in so congested a city as Chicago.

Seats. The seat proportions proposed do not appear to be liberal enough, especially for so wide a car. For comfort, cushions should be 17 in. x 34 in., and all seats in the car spring-backed. This requires a longitudinal spacing of at least thirty in., preferably more. In the 1912 car, the dimension of the closed section has resulted in cramping the spacing of cross seats in the open sections to 29 in. This should be increased. The size of the closed section is determined by the number of seats and the spacing allowed per person. Although the design calls for 17¾ in. per passenger, which is fair, the effective spacing has been reduced by the provision of vertical hand rods or stanchions at alternate seats, extending from the floor to the roof at the seat line. These hand rods reduce the actual spacing between stanchions to 34 in., which is not sufficient to allow two persons to ride together comfortably. Moreover, these stanchions in the present position will probably prevent uniform seating, inasmuch as there are no fixed divisions between the seats. They require six inches additional length in the closed compartment, which if applied to the open compartments, would increase the seat spacing to thirty in.—some improvement over the present spacing.

However, where longitudinal seats are used, these stanchions are desirable in place of straps, for the assistance of standing passengers, and if covered with white enamel as in modern rolling stock, they are sanitary and convenient. But in the absense of a more liberal spacing, they should be set out at least to the knee line, in which position they would interfere less with seated passengers, and would be fully as convenient for standing passengers as in the present plan. Without very liberal seat space per passenger, partitions must be used between seats if stanchions are to be set up against the seat line, and either condition requires so much extra length of car body that the number of cross seats in the open sections is reduced from six to four. Therefore, with this car body I should prefer the standard cross-seat arrangement within the closed section, or else the dimensions should be so modified as to obtain better results in both compartments.

Length of Car. This is limited by the permissible overhang of platform beyond the center line of trucks, and that of the projecting fenders used. On general principles, it is desired to increase the length of car body as much as possible, in order that the proportional cost of platform wages may be reduced and also the relative maintenance of parts. But, in any case, the platform overhang is the serious and determining factor, especially where narrow streets are encountered, owing to the resulting interference with adjacent car and vehicle traffic on curves. For prepayment cars, long platforms are necessary, and in order to reduce the overhang of the ends, trucks must be located as far apart as possible, and still keep the center overhang within reasonable limits.

In the case of the 1912 type of car, the proportions have been worked out to secure probably as good a design as could be produced under the conditions existing in this city. The distance between truck centers and car platforms is practically the same as in the Geary Street car. In either design, the end overhang cannot be reduced because of interference of trucks with the projecting underhanging platform side sills. In reasonably flat cities, two-motor, maximum traction trucks, with pony wheels extending out under the platform can be used, thus decreasing to some extent the platform overhang. But in San Francisco, two-motor equipments are impossible on account of the greater tractive effort required on heavy grades.

The only remaining method of reducing car overhang is by tapering the platform so that the corners of the bumpers describe an arc of somewhat shorter radius. In this respect, I cannot recommend the 1912 car, because of the fact that the platform has been designed of the same width as the car body on the assumption that with the use of a fender, the platform actually presented less overhang around curves than the corner of the fender, which now prevents clearance operation. But even assuming that this is true, it should not be assumed that the present type of fender is to be permanent.

Clearance operation is very essential in any system of rapid transit, surface or otherwise, and it is a fact that through the adoption of the "Eclipse" fender, specified by the Board of Supervisors, the clearance operation of cars around curves in San Francisco has been entirely nullified. Nevertheless, I feel that the development of a new car for either present or future should not embody this purely temporal condition and render clearance operation impracticable

[2]Width over belt rail 9 ft. 8 in., over body 9 ft. 0 in.

or dangerous. Consequently, tapered platforms should be embodied in the design. The only alternative is for the city to permit the spreading of tracks at curves sufficient to clear present fenders, which would result in an overhang of 15 in. over the standard curb of the Western Addition district.

Platform Arrangement.[3] Generally speaking, there is a certain relation between the area occupied by passengers in the car body and that of the platform; i.e., the larger the car, the more platform space is required. Where the prepayment principle is used, it is particularly necessary that ample storage space be available on the platform in order to avoid delaying the schedule due to slow loading, as would be the case with the short platforms. Moreover, every restriction placed in the way of free entrance of passengers must be removed. In the 1912 car, the principal difficulty is this contraction of the entrance space—first, by cramping the railing into the entrance passageway; and, second, by locating the controller directly opposite the contraction. There are three ways of improving this defect:

First: By straightening out the guide railing so as not to cramp the entrance way;

Second: By use of the master control system; and

Third: By placing the fare box next to the bulkhead and in the center of the opening, with the conductor immediately behind it standing on the car body floor.[4]

With the remote control system, only a very small master controller box is necessary on the platform, while the actual contact devices, connected thereto by an electric circuit, are all located underneath the car.

In the third method the present form of guide railing is entirely dispensed with, the guard rail for the fare box serving the purpose of dividing the bulkhead opening into entrance and exit passages. In this manner, the entire platform is open to passengers and the congestion at the entrance entirely eliminated.

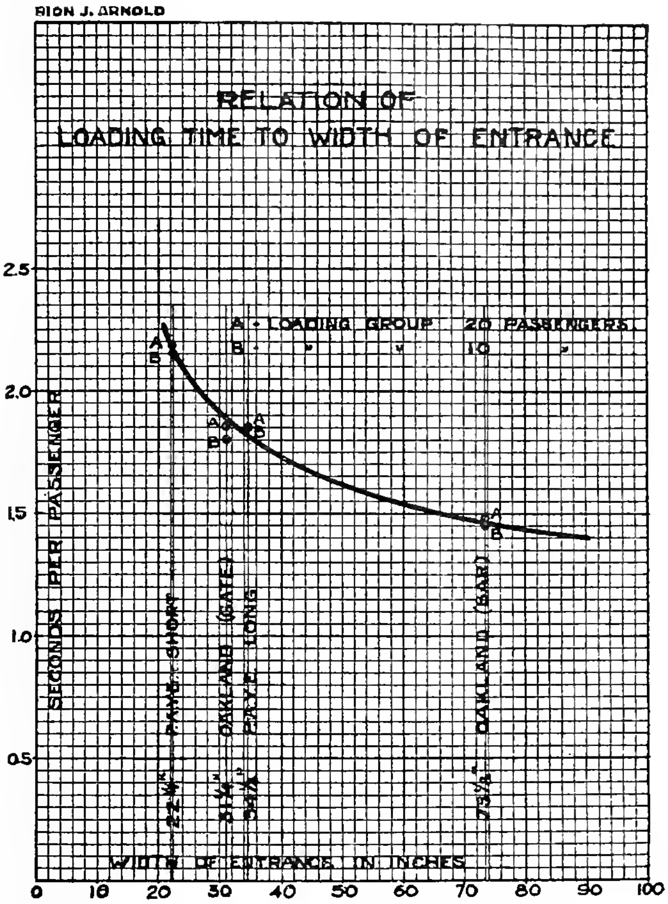
For the new rolling stock, one or more of these methods should be adopted; and in any case, the front exit gate should be removed from its present location next to the bumper to a position next to the bulkhead. This, in my judgment, is more desirable, so that passengers may alight quickly without having to force their way through standing groups which at present congest the space between the bulkhead and front exit gate.

By using the master control system as above proposed, and with the handrailing straightened, fully 50 per cent more entrance width will be available.

An advantage of the proposed location of exit gate next to the bulkhead is that two or three feet of length may be saved from each two-car safety station[5] along Market Street. At Kearny Street station particularly, this is of importance, owing to the difficulty in securing the proper length of station without interfering with street traffic.

In carrying out these improvements, the bulkhead should be left open with the maximum width between corner posts, in order to secure ample entrance and exit space. This is a definite advantage of the so-called "California" type of car, and the entrance and exit should not be contracted by false bulkheads such as wire screens or vertical railing.

Loading. San Francisco cars, unlike those of other cities, are called upon to handle two entirely different classes of service: (1) normal street traffic; and (2) terminal traffic at the Ferry, and it is the difficulty in handling large groups of passengers at terminals that has occasioned most of the recent criticism. In my judgment, the prepayment is by far the best system of operation that has been devised thus far,



Effect of Entrance Width on Loading Speed of Car.

6. Based upon observations of car loading, showing the relative time required to load a given group of passengers through wide and narrow entrances. For comparisons of this kind, the same sized group must be used, otherwise the comparison is valueless. These results conform in character to similar observations made upon different sized cars in Chicago. The data shows that the largest San Francisco platforms now in use requires 27 per cent more time in seconds per passenger than the Oakland cars using the radius rod.

but it must be perfected for these special conditions of service.

More rapid loading at points of congestion can be secured by the use of a radius rod in the guide railing, such as first used on the Oakland cars, and which has been adopted by the Geary Street car. By means of this radius rod, the entire width of step can be made available so as to increase the storage space at entrance, and thus load large groups of passengers more promptly than if half the step were used.

As an alternative, the radius bar may be omitted and the hand railing cut off about 24 in. back from the step, in a measure accomplishing the same purpose. This plan is now in use on some of the United Railroads cars.

Still another method of accomplishing the same result is by changing the position of the conductor's stand from the platform to the entrance of the car body as previously described, and by the elimination of the present form of guide railing. By this arrangement not only is the full step width made available for entrance, but the entire platform area can be used as storage space for passengers waiting to pay their fare.

A graphical demonstration of this relation between loading speed and width of entrance is afforded by Fig. 6, based upon observations on different widths of entrance at the step line. It will be seen here, that the long platforms of San Francisco require approximately 27 per cent more time in seconds per passenger than the Oakland car, using the full width entrance with the radius bar swung over to the bulkhead.

[3]Note.—With standard spiral casements at present used throughout the United Railroads system, the 1912 car theoretically clears on curves with a margin of four to six inches on the wider streets, and one to two inches on the narrower, exclusive of fender. But even this maximum clearance is out of the question on account of the possible list of the car on curves from various causes, such as eccentric loading, depressed rail, worn side bearings, failure of springs, etc.

[4]This plan is at present in operation in Cleveland.

[5]Recommended in Report No. 6.

At the Ferry and other heavy terminal points, it is very necessary that the platforms at both ends of the car be available for prepayment entrances. This may be accomplished in two ways:

First: By turning the front exit gate into an entrance gate, in which case only half of the full width between posts is available for entrance after the car is emptied.

Second: By opening the blind side of the front platform for the full width between posts for rapid exit, using front exit gate for entrance only.

Height of Steps. The height of steps involves many more details of design than appear upon the surface. In fact, to eliminate the last inch of height may require the redesigning of the trucks, bolsters, and car underframing. Furthermore, it must be recalled that any figure representing height of step is subject to considerable fluctuation due to the following causes:

First, after usage, the truck springs show a tendency to set, which may amount to from ¼ to ½ in.

Second, under maximum car load, the springs may compress 1¼ to 2½ in.

Third, due to wear, the wheel diameters decrease from 34 in., new, to 31½ in. maximum wear, dropping the entire car 1¼ in.

Fourth, due to wear of side bearings, steps may vary as much as one inch in height.

Fifth, permanent sag in platform underframing.

Due to one or all of these causes, the step of a properly designed car may drop from 2 to 4 in. from its position when new. Were the car originally designed with this low step, wear and stress would result in the platform lowering to a point where it would interfere with the operation of the trucks. Consequently, to secure this necessary truck clearance, the new cars must be designed with proportionately high steps.

The 1912 car submitted by the United Railroads appears to show careful design with respect to this step height, and the cars, when new, will have the first step about 15 to 16 in. from the pavement, which may eventually be reduced to 12 in. by wear and settling.

In the Geary street car, a simple device was made use of to reduce the height of step between platform and car body, in which the car floor was inclined from the center line of the bolster toward the end sill, so that the platform step is two inches lower than it would be with the level car floor. It is understood that this plan will also be adopted in the 1912 car, except that the platform instead of the floor will be sloped upward two inches in the form known as a ramp.

I regard it as very necessary that folding steps be used in the place of fixed steps. The object of the folding step is two-fold:

First. Lifting the steps on the blind side of the car will tend to discourage persons from endeavoring to steal a ride, and thereby incur the liability of accidents, as is the case when the steps are down.

Second. This practically obviates the possibility of collision or other interference with passing vehicles.

With the large number of overhanging steps now being operated in San Francisco, the danger from these two sources will be appreciated. In some pre-payment cars, designers have even gone to the length of automatically raising the steps when the vestibule door or gate is closed, so that while in motion, the car is entirely stripped of steps in the lowered position. Cars of this type may be found on the College Avenue line, Oakland, and in Boston and other cities.

Ventilation. Without having positive knowledge of the operation of the ventilating funnel shown on the 1912 car, I believe it should operate with fair satisfaction when the car is in motion. The principal objection I find is that there is no provision for the ventilation of the closed section while the car is standing still, and in this respect the Geary Street car is superior, in the use of the floor intakes by means of which natural circulation is provided for.

It is unquestionable that the fixed sash will result in slightly lower maintenance expense, but there will be times when it will be necessary or desirable to open the windows of the closed section. The Geary Street cars have raised sash, which I prefer to drop sash, on account of the increased cleanliness and the fact that the decreased thickness of wall may be taken advantage of for increasing the width of the aisle.

In conclusion, the 1912 United Railroads car may be regarded as a step in the right direction, and in general a considerable improvement over any of the types at present in operation here. It will prove fairly satisfactory for certain sections of the city where streets are wide enough to accommodate a wide car, as in the Mission.

Some features are quite commendable, such as the use of the turtle-back or arched roof and the position and type of illuminated signs; also the lowering of the steps by means of a platform ramp.

But if the design is intended for universal use throughout the city, or a standard for future equipment is under consideration, this car will require considerable modification, as outlined in the preceding discussion.

WATER-POWER DEVELOPMENT IN MEXICO.

A 99-year concession has been granted by the Mexican Government to D. J. Spillane, of San Luis Potosi, to take 50,000 liters per second from the Santa Maria River and 25,000 liters per second from the Gallinas River for power purposes. The works will be built within the territory extending from a point on the Gallinas River 2 kilometers above its junction with the Santa Maria River and on the Santa Maria from a point 10 kilometers above its junction to 2 kilometers below the junction. Plans of the location must be completed before May 20, 1913, and plans of the hydraulic works must be submitted before May 20, 1914, and work must begin within two months after approval of the plans by the Secretary of Fomento and to be completed within five years thereafter. The concession limits the prices which may be charged for power within 5 kilometers of the plant to 110 pesos per horsepower per annum, except for motors of 50 horsepower or less; for any distance greater than 5 kilometers from the plant prices may be increased by 10 per cent of the cost of installing the additional service. The company is exempted from taxes for five years with free entry of equipment. The concession may not be transferred to any foreign company or state.

It is understood that a company has been formed in the United States which has purchased the concession from Mr. Spillane, together with some 25,000 acres of land adjacent to the falls. The fall at the junction of these rivers is 106 meters. The falls are said to measure a normal flow of 40,000 horsepower, with excellent facilities for increasing the power by storage to more than 100,000 horsepower.

ELECTRICAL REPORTS FOR JUNE AND FOR THE FISCAL YEAR 1911-12.

The Bureau of Statistics of the Department of Commerce and Labor, Washington, D. C., has issued its monthly summary of the imports and exports of the United States for last June and, therefore, also its annual summary for the fiscal year ended June 30, 1912. From these statistics the following data on the exports of electrical products are obtained.

Due to the usual fluctuations from month to month, the figures for June show a falling off from those of the preceding month in both classes of electrical shipments, appliances (instruments and miscellaneous small apparatus) and machinery (heavy articles). This was not to be wondered at as regards the appliance exports, for those of May were extraordinarily large, breaking all previous records. The following table shows strikingly the monthly fluctuations in each class and in the totals during the past fiscal year and in June of a year ago:

Month.	Electrical Appliances.	Electrical Machinery.	Total.
June, 1911	$ 884,839	$825,091	$1,709,930
July, 1911	707,214	584,715	1,291,929
Aug., 1911	725,145	666,544	1,391,689
Sept., 1911	841,769	658,831	1,500,600
Oct., 1911	851,650	583,000	1,434,650
Nov., 1911	955,706	723,860	1,679,566
Dec., 1911	1,168,612	910,601	2,079,213
Jan., 1912	1,045,636	675,633	1,721,269
Feb., 1912	968,626	672,676	1,641,302
Mar., 1912	1,081,895	751,785	1,833,680
Apr., 1912	923,631	820,385	1,744,016
May, 1912	1,349,800	718,546	2,068,346
June, 1912	1,104,815	678,287	1,783,102

The following totals for the last six fiscal years, each including the twelve months ending June 30, show very conclusively the general trend of the electrical export trade. Among points of particular interest may be noted the marked slump of 1908 and 1909 and the excellent recovery therefrom in the more recent years, particularly in appliance exports, which have nearly doubled in the last three years and have since held the lead over the machinery shipments.

Year.	Electrical Appliances.	Electrical Machinery.	Total.
1906-07	$ 8,262,640	$9,005,766	$17,268,406
1907-08	6,754,217	8,495,219	15,249,436
1908-09	6,074,865	6,449,526	12,524,391
1909-10	8,694,132	6,048,263	14,742,395
1910-11	10,702,827	8,024,628	18,727,455
1911-12	11,724,499	8,444,863	20,169,362

Reverting back to the figures for last June, the principal countries to which electrical shipments were made and the values of these exports are given below:

Countries.	Electrical Appliances.	Electrical Machinery.
United Kingdom	$ 38,202	$ 46,646
Canada	352,371	190,743
Mexico	103,121	90,370
Brazil	240,797	41,739
Japan	109,494	87,887
Total	$843,985	$457,385

The first direct communication between the Mare Island Navy Yard of California and the recently completed Pribyloff wireless station in Alaska was established recently. The operators conversed freely over the distance of 3100 miles. The Alaska station has just been overhauled by wireless experts from Mare Island.

VISITING-MEMBER PRIVILEGES WITH FOREIGN ELECTRICAL-ENGINEERING SOCIETIES.

For some time past the Board of Directors of the American Institute of Electrical Engineers has desired to promote closer relations between the Institute and foreign electrical engineering societies. The advantage of a closer understanding was especially felt last year, when so many Institute members went abroad to attend the International Electrical Congress at Turin, and the meeting of the International Electrotechnical Commission. On receiving the report of Gano Dunn, who as president of the Institute headed its delegations to both of these meetings, the Board, feeling that it would not only promote mutually the convenience of visiting engineers both to this country and abroad, but would also increase the friendly relations which are constantly growing through the activities of the International Electrotechnical Commission and other similar agencies, passed the following resolution:

Resolved, That the President is authorized to communicate with certain leading foreign electrical engineering societies with respect to establishing mutual visiting-member privileges for a limited term, with the end in view of contributing to the convenience of our own members visiting foreign countries, and, in return, affording corresponding conveniences to members of foreign electrical-engineering societies visiting the United States, and of increasing the friendly relations between American and foreign engineers.

Accordingly a number of European electrical engineering societies were communicated with by President Dunn, and the following have cordially accepted the Institute's proposals to enter into reciprocal arrangements:

Institution of Electrical Engineers (Great Britain), Verband Deutscher Electrotechniker (Germany), Societe Internationale des Electriciens (France), Associazione Elettrotechnia Italiana (Italy), Koninlijk Instituut van Ingenieurs (Holland), Association Suisse des Electriciens (Switzerland). The Svenska Teknologforeningen (Sweden) will take up the question at the meeting of its governing body in the fall.

The arrangements entitle members of the Institute of Electrical Engineers while abroad to the privileges of members of the societies designated, for a period of three months, and foreign members visiting this country are entitled to the privileges of Institute membership for a like period.

To foreign engineers visiting this country it is proposed to give, upon presentation of proper credentials, letters of introduction to Institute members and to officers of manufacturing and operating companies; also to place at the disposal of visitors the facilities of the library, in which are a large number of books in foreign languages, and the reception, reading and writing rooms at Institute headquarters. Visitors may also have their mail received and forwarded.

There has been prepared for the use of Institute members while abroad a form of certificate to be signed by the secretary, which will serve as credentials from the Institute to foreign societies. A separate certificate is necessary for each foreign society.

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Electrical Exports

The electrical activity of Canada to the north and Mexico to the south has been noted considerably in these columns of late. Especially has this activity made itself manifest in Western Canada. On a previous occasion mention was made of the fact that a gigantic demand for electrical apparatus would inevitably come in the near future from the reawakening of China. Indeed this reawakening is already being anticipated by American manufacturers in an endeavor to secure a firm foothold in the neighboring country of Japan. A summary of the electrical exports for the past year may be found on another page. Western men will be interested in noting that of the principal countries to which electrical appliances were shipped during last June, for instance, 74 per cent went to either Canada, Mexico or Japan, while 81 per cent of the shipments in electrical machinery was exported to these countries. Examining more closely we find that of the 74 per cent in electrical appliances 46 per cent went to Canada, 14 per cent to Mexico and 14 per cent to Japan, while of the 81 per cent in electrical machinery 42 per cent went to Canada, 20 per cent to Mexico and 19 per cent to Japan. The outlook for continued electrical activity with our Western neighbors is indeed promising.

Water Development for Western Cities

Western municipalities, anticipating continued prosperity and a growth in proportion to past realizations, are truly active in their efforts to solve the problem of adequate water supply.

Portland was the first Western city of large proportions to look to the distant snow-capped mountains for the charms there to be enjoyed and captured by developing a pure and wholesome natural domestic supply. The reduction of a rather startling death rate to a rate considerably lower than other cities of its size was the immediate result. But far more than this material accomplishment is the civic pride engendered in every citizen of Portland when he turns his eyes to the Mecca of the Rose City—Mt. Hood—whence issues this ideal supply.

Los Angeles, in accord with its traditions of the past, is soon to give to the world another record-breaking accomplishment, that of the Los Angeles Aqueduct.

The bringing of water, now losing itself in a sunken lake, but soon to pierce the dizzy mountain peak and cross the burning deserts, to that city—a distance of some 240 miles—is a municipal triumph which deserves the reputation the feat enjoys at the present time. The clock-like accuracy with which the gears and ratchets of the aqueduct organization are working is no less a triumph, however, than the actual material feat itself. Indeed, the two other cities—Seattle and San Francisco—which are now planning their water supply in the embryo, may well look to the organization of the Los Angeles Aqueduct for pointers in planning the future undertaking.

Cedar River, from which Seattle plans to obtain its domestic supply, has as a lowest recorded run-off in years between 1903 and 1911 a supply sufficient for the needs of a city of 1,306,000 people at an average daily consumption of 100 gallons for each inhabitant. Further than this, if, when needed, impounding dams are constructed to hold the surplus waters during seasons of largest flow, it is possible to make ample provision for the supplying of a city of 3,920,000 people from this same source. Seattle has shown foresight in securing the control of the entire watershed of this pure and beautiful stream, thereby enabling the proper authorities to protect it from the possibility of contamination.

San Francisco, on the other hand, is considering a scheme far more audacious than even that of the Los Angeles Aqueduct. According to the advice and investigation of its consulting expert, John R. Freeman, it is proposed to bring water from the Hetch Hetchy valley by means of a gravity system throughout and in sufficient quantity to supply not only San Francisco and its estimated growth for the next three generations, but all the cities about the bay region—Oakland, Berkeley, Richmond, Alameda, San Jose—are invited to join in the enterprise. In the ultimate the scheme will provide water sufficient for 6,000,000 people on the 100 gallon per capita basis and in addition the several drops en route will be of sufficient proportions to develop 100,000 horsepower.

Such gigantic enterprises, hitherto, ungrappled with by municipal authorities, may well be guided by the words of George Westinghouse: "It is cheaper to buy experience than to manufacture it." The recent appointing of M. M. O'Shaughnessy, the well-known water expert, at an unprecedented salary in San Francisco engineering administration as city engineer of San Francisco, is a happy augury for the promotion of the successful accomplishment of the big enterprises ahead.

The Arnold Report on Car Design

The transportation problem of San Francisco is more than of local interest. Our readers will find elsewhere in this issue the conclusions of Bion J. Arnold relative to improvements in proposed rolling stock for the Exposition City.

In a comprehensive discussion of the modern street car, seven topics must necessarily enter in the argument—seating arrangement, facilities for quick loading and unloading, storage space, car proportions, height and type of steps, ventilation and lighting, and designating signs. Of these seven features, seating arrangement, height of steps, and ventilation enter more toward the personal comfort of the public than any others. In the recent growth in heavy enclosed steel rolling stock the last point mentioned above enters profoundly into comfortable transit considerations during overload periods of traffic congestion.

The editorial staff of this Journal have taken considerable pains to collect data on this subject during the past year from as widely varying sources as possible, both in San Francisco and the cities about the bay. Our conclusions are that so far as the cross-seat versus the longitudinal arrangement is concerned the traveling public have little patience or sympathy with the latter mode of seating. The rapid acceleration or deceleration of cars gives such a decided discomfort no pleasure is to be found in cars where many stops are made and seating of this nature wholly predominates. The design submitted by Mr. Arnold proposes more cross-seats than the United Railways design and is truly to be commended in this regard.

While the hobble skirt still continues to limit the tractive effort of many of the new voters in California, yet as a whole Western common sense has predominated among our women in this regard—at least to such an extent that the delays due to the out-of-reach step can not be said to be due to this mode of dress, for the careful observer will note that the painful puffing and blowing in climbing into the car comes as much from those of the sterner sex as from the women. The authorities of the United Railroads in proposing to reasonably lower the necessary lift at the entrance of the new car are to be commended for their attitude.

The most crying evil, however, in recent car design is that of almost criminal neglect in ventilation. The solid steel car is undoubtedly safer in accidents and from nearly every other point of view is to be hailed with joy when put into operation by an enterprising traction company. Yet how wofully far short do these cars fall many times in the eyes of the traveling public! To find the cause ask varying groups of those utilizing this conveyance and practically a unanimous verdict will be rendered that ventilation has been frightfully neglected in modern car design. In his report Mr. Arnold states that, without having positive knowledge of the operation of the ventilating funnel shown on the 1912 car, he believes it will operate with fair satisfaction when the car is in motion, though he finds no provision for ventilation while the car is standing still. A beautiful and emphatic lesson in ventilation may be learned by riding upon the new enclosed steel cars of the Telegraph avenue line of the Oakland Traction Company. Here is a line feeding the next to the largest university in America, a line where seven thousand students might learn the best that is in modern traction evolution. Ten years ago this line was abreast of the times and with pride pointed to by thousands of visitors, and yet today with its jostling, jolting longitudinal seats and its dense, unwholesome air in the enclosed section, many are prone to avoid going from Berkeley into Oakland, preferring to cross over into San Francisco rather than endure the torture offered them in taking this formerly beautiful and instructive ride.

In contemplation, then, of the new car design for San Francisco, positive information should be gathered on this important subject and every effort made to induce the salubrious atmosphere of the Bay City to enter the enclosure.

PERSONALS.

J. J. C. Forney, a telephone official of Los Angeles, is a recent San Francisco visitor.

H. E. Greer, is a delegate from Spokane to the meeting of the National Association of Stationary Engineers at Kansas City September 9 to 14.

J. C. Love, assistant superintendent of meters of the Sacramento division of the Pacific Gas & Electric Company, is a recent San Francisco visitor.

H. R. Noack, president of Pierson, Roeding & Co., recently returned to San Francisco after spending his vacation in a tour of the Pacific Northwest.

H. C. Goldrick, Pacific Coast manager for the Kellogg Switchboard & Supply Company, has returned to San Francisco after a tour of Nevada.

B. M. Mehl, in charge of maps and records of the Sacramento division of the Pacific Gas & Electric Company, spent last Tuesday in San Francisco.

A. E. Rowe, the San Francisco sales manager of the Telephone-Electric Equipment Company, has returned to San Francisco from an extensive vacation trip.

Dr. Ernst J. Berg, professor of electrical engineering at the University of Illinois, spent several days at San Francisco this week on his return from a visit to Japan.

James T. Whittlesey has resigned as chief engineer of the Public service Electric Company, Newark, N. J., to engage in consulting practice in San Francisco. Cal.

H. B. Squires, of the firm of Otis & Squires, will leave for Los Angeles next Monday and will, later attend the Pacific Coast Gas Association Convention at San Diego.

H. C. Vensano, civil engineer, with the Pacific Gas & Electric Company, left this week for the East to make tests on new designs of steel transmission line towers at the builder's factory.

Fred L. Webster, head of the Allis-Chalmers Company's Pacific Coast department, returned to San Francisco during the week from a brief business trip to Los Angeles, where a branch office is maintained.

Samuel B. Christy, dean of the school of mines at the University of California, has been appointed on the general committee to raise funds for the Kelvin memorial now being formulated by the great engineering societies of the world.

W. Scott, the general engineer of the Westinghouse Electric and Manufacturing Company, who is making a tour of the company's Pacific Coast branch offices, arrived at San Francisco during the week. He will visit Los Angeles next.

Chester H. Pennoyer, manager of the San Francisco agency for the National Conduit & Cable Company and the National Brass & Copper Tube Company, has returned from a business tour of the Pacific Northwest. He reports a favorable business outlook in his lines.

W. D. Donald of San Francisco has been appointed by the board of public works as an inspector of car construction. Mr. Donald's duties will be to see to it that the cars for the Geary Municipal road comply in every detail with the plans prepared by Bion J. Arnold.

A. B. Saurman, manager of the Standard Underground Cable Company's Pacific Coast department, has returned to San Francisco from Eureka after an automobile vacation tour of Mendocino and Humboldt counties with a party of friends. The hunting and fishing was excellent.

J. B. Lukes, representative of the Stone & Webster Construction Company, has returned to his San Francisco office from Los Angeles, where he met **S. L. Shuffleton**, who has general supervision of the construction and other work on the Pacific Coast. Good progress is reported on the Big Creek hydroelectric development.

Marsden Manson, the retiring City Engineer of San Francisco, was presented recently with a silver loving cup by the employees of the Bureau of Engineering Department of the Board of Public Works. Manson, who resigned his position account of ill health, will take a rest in the country.

Arnold Pfau, hydraulic engineer with the Allis-Chalmers Company, is on his way to Milwaukee after doing some important work in San Francisco, in connection with large hydraulic contracts that are pending.

A. W. Bullard, general manager of the Great Western Power Company, and **P. T. Hanscom**, the general superintendent, returned to San Francisco last Wednesday, after spending several days in an inspection of the construction work in progress at Big Meadows dam and Los Plumas power house. Seven hundred men are working on the dam and seventy-five on the power house extension. Concrete is being poured at both points and the low stage of water in the river permits of rapid work.

F. B. Gleason, who, for some years past, has been manager of the Western Electric Company's San Francisco branch, has just received the appointment as Far Eastern manager for that company, with headquarters at Tokio, Japan. He will be in charge of the company's factory at that point and will have general supervision of China and Japan territory. **P. J. Condict**, the present representative of the Western Electric Company in Japan, will return to this country. Mr. Gleason will leave San Francisco within the next two weeks and go to the Orient via Europe and the Suez canal. He will remain at his new post for a term of three years.

J. R. Bibbins, resident engineer for Bion J. Arnold at San Francisco, has returned from Sacramento after a preliminary investigation of the Sacramento electric railway problem. The Pacific Gas & Electric Company, which owns this road, on its own initiative has engaged Mr. Arnold to report upon these properties, this probably being the first example on the Pacific Coast of a public utility voluntarily instituting an examination of its properties without orders or other restrictions from municipal or State regulative authorities. As announced in these columns last week, this work will be of the broadest scope, covering in general the question of standards of service and equipment, improvements in the type of cars, the re-routing of cars, the development of better terminal facilities, especially at the railroad stations, the improvement in schedule speed and general operating conditions, and the possibilities of further extensions within the limits of a reasonable return upon the value of the property as determined by appraisal, which has already been made. The corporation has advised the Municipal Commission of Sacramento of its action and that it will ultimately place before the Commission the complete results of the Arnold investigation.

M. M. O'Shaughnessy has been appointed City Engineer of San Francisco to succeed Marsden Manson, resigned. The appointment was made by the Board of Public Works upon the recommendation of Mayor James Rolph Jr., who has practically given O'Shaughnessy carte blanche to do what is best for the city's interests, with authority to reorganize the City Engineer's department where necessary. Mr. O'Shaughnessy is 48 years of age and has resided in California 27 years. He is a graduate of the Royal University of Dublin. He first attained distinction in this State by serving as chief engineer of the Midwinter Fair at San Francisco. After the fair closed he became chief engineer for the Mountain Copper Company in Shasta County. Next he became chief construction engineer for the Crocker-Huffman Company, and built the irrigation dam on the Merced River. Later he was chief engineer for the Southern California Mountain Water Company constructing its aqueducts and plant, including the Morena rock-fill dam, the largest of its type in California. The city of San Diego is supplied with water from this system. As consulting engineer for no less than fifteen water supply plants in the Hawaiian Islands, O'Shaughnessy constructed four large aqueducts. The Throttle irrigation dam is another specimen of his work. O'Shaughnessy is a member of the American Society of Civil Engineers.

JOVIAN LUNCH CLUB OF SAN FRANCISCO.

The regular weekly lunch of the Jovian Lunch Club of San Francisco was held at Tait's Cafe on September 3 with an attendance of about sixty. T. E. Bibbins presided. The report of the nominating committee for officers for the ensuing year was adopted and the following declared elected: R. M. Alvord, W. W. Hanscom, F. H. Woodward, W. S. Hanbridge and F. H. Poss.

The membership committee reported that many desirable applications had been received for initiation at the rejuvenation on Jovian Day, September 10. Geo. C. Holberton entertainingly explained a magnificent collection of lantern slides illustrating the system of the Pacific Gas & Electric Company, particular emphasis being laid on the new work in Bear Valley.

PROGRAM FOR TWENTIETH CONVENTION PACIFIC COAST GAS ASSOCIATION.

The following arrangements have been made for the Twentieth Annual Convention of the Pacific Coast Gas Association to be held at San Diego, Cal., September 17th, 18th and 19th, 1912:

President's Address .... William Baurhyte

1. Commercial Gas Illumination .... W. T. Pease
2. Calorific Value of Oil Gas.................... F. S. Wade
3. Welding of High Pressure Pipe Lines.... Leon B. Jones
4. Quality of Fire Bricks for Use in Oil Gas Machines.. .... D. J. Young
5. Reasonable Gas Rates and Their Determination.... .... Prof. C. L. Cory
6. Perfect Service .... C. P. Houghton
7. Should Gas Companies Engage in the Sale of Appliances (Composite Paper)..L. H. Newbert, H. P. Pitts
8. Sale of Gas Appliances by a Small Gas Company.... .... F. A. Cressey, Jr.
9. Present Status of Gas Engineering in American Universities, and Some Suggestions for a Specialized Course on the Pacific Coast...... Prof. Robert Sibley
10. Wrinkles .... F. C. Millard
11. Experiences .... Wallace H. Foster
12. Novelties .... R. L. Clarke

The meetings will be held in the assembly room of the Grant Hotel, and will be called to order promptly at 10 o'clock a. m., September 17th.

Banquet: The banquet will be held in the Grant Hotel on Wednesday evening, September the 18th, at 7 o'clock.

On the evening of the banquet the ladies of the party will be the guests of the San Diego Consolidated Gas & Electric Company at a theatre party.

Outings: On Tuesday, September 17th, and Wednesday, September 18th, the ladies of the party will be entertained by automobile sight-seeing trips in and around San Diego.

On Thursday, September 19th, the members of the Association and ladies accompanying them will be taken in automobiles to all points of interest in and around San Diego as guests of the San Diego Consolidated Gas & Electric Company. The party will leave the Grant Hotel at 9 o'clock a. m. on this trip, returning to the Grant Hotel at noon, where luncheon will be served.

After luncheon, the party as guests of the United Light, Fuel & Power Company will be taken for a trip around San Diego Bay, returning to San Diego at 5 o'clock p. m.

On Thursday evening, September 19th, a ball will be given at the Grant Hotel by the San Diego Consolidated Gas & Electric Company for the members of the Association, ladies of the party, and invited guests.

TRADE NOTES.

Chas. W. Comstock, the well-known consulting engineer of Denver, has undertaken the position of engineering manager for the Goldsborough Company. In his new position, Mr. Comstock will have the general direction of all the engineering departments of the company.

The Dodds-Caffray Company, general sales agents, on September 1st, passed into the hands of The Electric Sales Company, who recently incorporated for the purpose of conducting a general electrical sales agency business on the Pacific Coast. Sales offices will be maintained at San Francisco and Los Angeles. W. C. Caffray is the president and general manager of the new organization.

Garnett Young, manager of the Telephone-Electric Equipment Company, reports that his Seattle office, F. G. Larkin, manager, has secured the awards of a Government contract for about two carloads of weather-proof wire and cables for the new electric lighting installations at Forts Ward, Flagler, and Worden on Puget Sound. The wire will be manufactured by the American Electrical Works, of Phillipsdale, R. I., represented by the Telephone-Electric Equipment Company.

It is understood that the Westinghouse Electric and Manufacturing Company will supply the main generators and other electrical equipment for one of the two power stations to be constructed on Big Creek for the Pacific Light and Power Company. Each of the two generators will be rated at 17,000 k.v.a., 6600 volts, at 279 r.p.m. As before stated in these columns, the General Electric Company was awarded the contract for two similar generators for the other power house and the Allis-Chalmers Company the water wheels for both plants.

J. H. Wise, assistant general manager of the Pacific Gas & Electric Company and the staff of engineers have been very busy during the past two weeks over the bids for the hydroelectric equipment for the new South Yuba development. A total capacity of 40,000 h.p. is to be provided for, and as a force of 1700 men is at work at the site of the plant no time will be lost unnecessarily in closing the remaining contracts. The steel towers were awarded to Milliken Bros., and the insulators for the tower line to the Ohio Brass Company.

NEW CATALOGUES.

The Westinghouse Electric & Mfg. Company have issued several new leaflets and folders. Folder 4230 entitled "How Westinghouse Small Motors Can Help You" is an attractive little publication describing with illustrations, some of the manifold uses to which small electric motors can be put. The views show actual installations in the home and in the shop of the small motors. The publication is intended for dealers and central stations, space being left for their name on the back. Leaflet 2457 covers Commutating Pole Rotary Converters. These devices are described and illustrated in detail and considerable interesting information is given covering their construction. Leaflet 3506, in a series of Westinghouse paper mill motors, has just been issued and covers motors for pulp mill service. Illustrations are shown of motors in operation and considerable interesting data is given as to the use of electric motors in this industry. Leaflet 2444 covers the equalizer flywheel hoisting sets used in conjunction with electric hoists. Application views together with the diagram of connections showing the liquid rheostat are also given. The leaflet also describes the system in which these devices are used. The No. 10 issue of "Small Motors" is devoted to several interesting stories of experiences enjoyed by various people with motors in the home. These stories are illustrated and furnish interesting advertisements for central station new business departments. Descriptive Leaflet 2359-A illustrates and describes the type SK direct current, commutating pole motors.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

INTERIOR TELEPHONE WIRING.

BY E. J. BURKE, M. E.

Low voltage interior wiring for telephone and telegraph has been very slowly granted the attention it deserves. This is partly due to two causes. In the first place the voltage and current on such lines is so small as to eliminate any possibility of arcing at a short circuit or ground and thus causing fire. There being no danger in using any method for putting up such interior wiring, telephone and telegraph companies were slow to consider the amount of time and energy wasted and consequent loss of money due to such careless methods.

In the second place, for a long time there was no really practical and effective driven wire support on the market which afforded the necessary mechanical protection.

At first the best driven wire support for such wiring was a small bare staple or double-pointed tack. This furnished a neat and apparently good support and was largely used for such interior wiring. The telephone companies were the first to discover that these bare staples, when driven over their twisted pair wires, would in a short time corrode. This corrosion of the metal would quickly destroy first, the cotton covering on the wire, then, the rubber covering and there you had a short circuit and the telephone in that particular house was out of commission. While the trouble was quickly remedied when found, it frequently required several hours' time of a high priced trouble hunter to locate it.

The telephone companies then adopted the method of driving the staples over one leg only of the twisted pair wires. This prevented short circuits caused by a wireman driving a staple too hard and cutting through the insulation on the wire but did not prevent the corrosion of the metal gradually destroying the insulation on both wires as before and causing short circuits and grounds which, until found and removed, put that particular telephone out of business.

A staple was needed having a firmly fixed insulating saddle under the head which would give the required mechanical protection to the insulation on the wire and prevent the insulation from coming in contact with and being destroyed by the bare metal of the staple. It is also necessary that this insulated staple should have good driving qualities, that is drive easily into woodwork of various kinds without splitting the wood or itself bending and skating and that the insulation should be so well fixed that it could not possibly fall out when the staple was being driven. As soon as such a staple was placed on the market it was at once taken up by the most up-to-date telephone companies which realized that their cost of trouble hunting on interior wiring due to defective supports was running into thousands of dollars per year.

An insulated staple of proper design and construction is far superior to any single pronged wire support for such purposes for the following reasons. In the first place, an insulated staple driven over all the wires furnishes absolute protection to the insulatiou on the wires. A single pronged support driven between the wires does not furnish such protection as its bare shank is resting against the wire. Again, in driving anything between twisted pair wires the wireman is apt to drive through the insulation and destroy it. An insulated staple holds the wires firmly and will hold the slack; a single prong fastener will not. Therefore, fewer staples have to be used and they really cost less not only for material but also for labor.

When turning corners an insulated staple holds all the wires together with the strain on all of them, whereas, with a single prong fastener all the strain is thrown on one of the wires. In this case too the staple is still affording perfect protection to the wire, whereas, with a single prong fastener the wire is pulled tight against practically the bare metal shank.

The insulation on an insulated staple can be made of durable fibre which will last forever and cannot be pulled off. On many single prong fasteners the heads fly off under any strain and on others a rubber tubing, which quickly rots out, must be used to protect the shank.

Staples can be used over single ground wires, single prong fasteners cannot be. Therefore, the amount and varieties of stock carried can be reduced by using only insulated staples. When staples are used the wires do not have to be separated with consequent delay and added labor cost.

The above covers interior telephone wiring where it can be ran over wood work and a driven wire support used. Where wiring must be run over plastering or where a screw fastened support is desired a cleat is necessary.

The requirements for a proper form of cleat are that it should be strong, durable, hold the wire effectively, and small and inconspicuous as possible. The cleat should be of such material as not to split or crack either in handling or when screwed up tight enough to hold the slack wire.

It has been proved absolutely that a little extra money expended in buying the proper material for interior telephone wiring will pay for itself many times over in saving the time and expense of hunting small troubles and interruptions to service due to short circuits, grounds and even open circuits.

NEWS OF THE ELECTRICAL CONTRACTORS.

The Evans-Dickson Company of Tacoma has the contract to extend the electric wiring in the Federal building and install additional lights in the mailing room.

NePage McKinney & Co. of Seattle have the contract for the electrical work in the new Multnomah County library building, under construction in the city of Portland.

George H. Waite, formerly in the electrical contracting business in Walla Walla, has transferred his business to La Grande, Ore.

NEW CATALOGUES

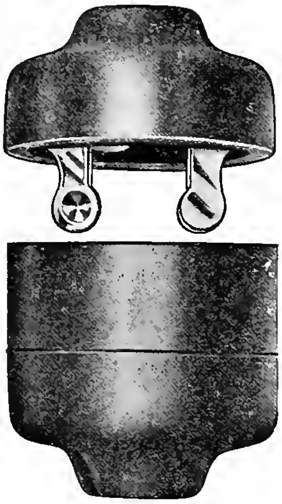
The Crocker-Wheeler Company are distributing Bulletins Nos. 153 and 154. The former deals with direct current lighting and power generators and the latter with oil-insulated self-cooled and water cooled transformers.

The General Electric Company has just issued a bulletin which illustrates and describes its Resistance Units for various motor-starting and speed-controlling rheostats. The number of the bulletin is 4973. Bulletin No. 4975 is a revision of Bulletin No. 4613, devoted to the Synchronism Indicator. Bulletin No. 4977 describes Type MK control apparatus, which is designed for use where single car operation predominates, and where a uniform acceleration is not of such importance as extreme simplicity. This bulletin supersedes, in part, Bulletin 4761. Bulletin No. A4001 describes oil switches which are intended primarily for use in small and isolated alternating current plants of voltages not greater than 3300. The bulletin contains connection and dimension diagrams, and also useful formulas for use in selecting oil switches. Bulletin A4002 describes Polyphase Maximum Watt Demand Indicator, Type W. The instrument is suitable ror recording the maximum lead of alternating current circuits irrespective of power-factor and voltage fluctuations.

INDUSTRIAL

NEW COMPOSITION CORD CONNECTORS.

The cord connector finds many uses with the increasing number of portable electric devices. Tailoring and laundry irons, electric drills, etc., can be easily connected and disconnected by means of a cord connector placed on the cord within convenient reach of the operator. With portable vacuum cleaners they provide handy means for disconnecting the long portable cord from the cleaner. A table or desk lamp connected by a cord of considerable length to a base plug can be easily disconnected by means of a cord connector placed near the lamp. To move the lamp or table it is then only necessary to pull out the cap of the connector and the cord, often run under the rug, need not be disturbed.



Cutler-Hammer New Composition Cord Connector.

A black composition cord connector put on the market by the Cutler-Hammer Manufacturing Company of Milwaukee, is shown in the accompanying illustration. The contacts lock firmly and yet are separated by a pull in any direction. The composition body is made of the insulating material developed in the Ceramic Laboratory of the Cutler-Hammer Manufacturing Company, and which has been used in making other Cutler-Hammer specialties. This material is eminently suited for this device because it is tough and moulds accurately.

THE FLYING OFFICE.

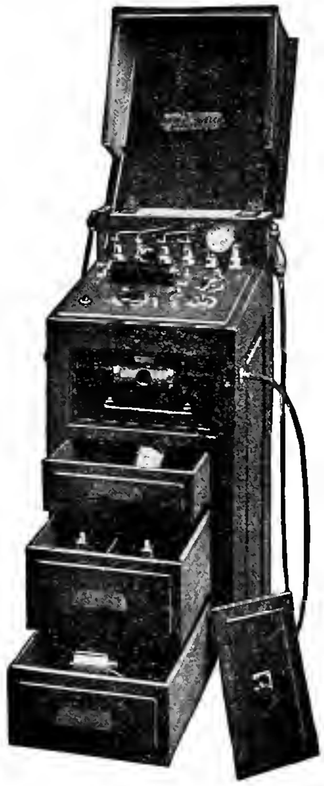
In the annals of naval and land warfare we have heard much of "flying squadrons." It remained, however, for the telephone to make it possible for railway officials to have what may be termed a "flying office." A prominent railroad official recently said, "We railroad men don't have to be tied down to our city offices any more. We can get around over the lines, and see what is going on with our own eyes. Neglect our routine business? Not much! We do just as much if not more, with modern methods."

This is all brought about by the fact that the majority of the private cars in the United States are now equipped with Western Electric telephones, which may be connected at each stopping place to the telephone line by means of a line pole. Over the telephone circuit thus established, the official transacts his routine business as well as takes care of any emergency which may arise. He dictates his memoranda, and even his more lengthy letters, to his secretary or stenographer, who is at headquarters. His private car is his office and without neglecting every-day matters he can make inspections or personally supervise any work, such as clearing up a large wreck, the replacing of a bridge or the clearing of a snow or land slide, while keeping his finger upon the "pulse of the road."

PHYSICIAN'S ELECTRIC CABINET.

Every physician knows the value of many forms of electrical apparatus in therapeutics, but also realizes that the purchase of each one would involve a large investment of money and expensive storage space.

These difficulties are, however, overcome most happily in the compact cabinet illustrated herewith. This device provides, among many other conveniences, a vacuum apparatus, a hot air douche, compressed air without the use of a tank, and vibration upon an entirely new principle. It weighs less than 100 lbs., but places the physician in a position to take care of patients himself whom he would otherwise be compelled to send elsewhere.



Physician's Electric Cabinet.

The vibration, so essential in modern therapeutics, is obtained by causing air to pulsate against a thin disc or diaphragm at the rate of about 5000 times a minute. This action is claimed to resemble nature more nearly than does any other device.

The compressed air and the vacuum obtained are produced by means of a unique fan or blower attached to a 1-10th horsepower motor operating at 1700 revolutions per minute.

Among other electric functions performed by this device are the furnishing of what is known to the medical profession as Galvanic, Foradic and Diagnostic lamp currents when used on 100 volt d.c. circuits and Sinusoidal, instead of Galvanic, current when used on a 110 volt a.c. circuit. The latter can then be furnished through a rectifier.

The cabinet complete with its accessories is made by the Siebert-Welch Company of Columbus, Ohio, and the electric motor for operating the air pump is made by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

NEWS NOTES

ILLUMINATION.

PUYALLUP, WASH.—Bids are soon to be called for lighting the city.

LYMAN, WASH.—The Pacific Northwest Traction Company has made application for a franchise to light the city.

REDWOOD CITY, CAL.—An attempt will be made to extend the city's lighting system through the means of a bond issue, an election for which will be called in the near future.

SALT LAKE CITY, UTAH.—The City Commission passed the ordinance awarding a franchise to the Merchants' Light & Power Company, of Ogden, for the installation in Salt Lake of an electric light and power system.

KIRKLAND, WASH.—From the management of the Kirkland Light & Power Company comes the statement that action would immediately be taken in building a power house here. The machinery for the power plant has been ordered.

VANCOUVER, B. C.—It is announced that application will be made to the government by Bloedel, Stewart & Welch Ltd., for a license to develop a valuable waterpower on the Cheakamus River. The estimated expenditures are $2,000,000.

KAMLOOPS, B. C.—Petitions were read from taxpayers for the submission of three by-laws: $250,000 for a hydroelectric power plant; $90,000 for improvements and extensions to the city water works system; $65,000 for extension and improvement of the city electric lighting system.

MONTPELIER, IDAHO.—The Telluride Power Company is planning for $1,750,000 improvements, including completion of the Bear River reservoir in Utah and Idaho, building of an irrigation reservoir on Bear River at Soda Springs, Idaho, and a generating plant at Oneida Narrows, Idaho.

PALO ALTO, CAL.—The Palo Alto Gas & Electric Company has filed with the Railroad Commission its answer to the complaint of the city of Palo Alto asking the company be compelled to reduce its rate of $1.50. The company agrees to reduce its rate either to a flat rate of $1.40 or a rate of $1.45 to small consumers and a sliding scale down of $1.20 to large consumers.

TRANSPORTATION.

SAN DIEGO, CAL.—The City Council has granted a street railway franchise to the San Diego Electric Railway Company to operate for a period ending in 1952, in this city.

MARTINEZ, CAL.—A deed conveying to the Oakland & Antioch Railway a right of way for several miles through the Rancho Los Medanos, has been filed for record by the C. A. Hooper Company.

KLAMATH FALLS, ORE.—According to George C. Clark, contractor, the electric railway to connect Bonanza with this place is assured. A preliminary survey is almost finished for the entire 26 miles.

BOISE, IDAHO.—The County Commissioners have granted an additional franchise to the Idaho Railway, Light & Power Company to proceed with the construction of the electric road south of Morris Hill cemetery.

LEWISTON, IDAHO.—Z. A. Johnson of Nez Perce announces that he will soon begin the construction of his proposed electric line out of Lewiston through the Camas and Nez Perce prairies at a cost of $1,500,000.

ORENCO, ORE.—The proposed electric line between Helvetia on the United Railway line will probably be constructed this year. J. H. Young, president of the Oregon Electric Railway Company, and others have been here inspecting the route.

OLYMPIA, WASH.—Starting September 1, the Pacific Northwest Traction Company will operate its new interurban line between Bellingham, Mount Vernon, Sedro-Woolley and way points. The company will charge about 3 cents a mile.

LOS ANGELES, CAL.—The Pursell electric line, projected between Los Angeles and San Diego will be completed at once as far as Escondido from the southern terminus if the promoters gain the consent of the State Railroad Commission to place the bonds.

RIVERSIDE, CAL.—W. W. Poole, manager of the Riverside Portland Cement Company, which corporation also controls the Crescent City Railway Company, says that the Rialto extension of the Riverside-Bloomington line will in all probability be in operation by April next.

MERIDIAN, CAL.—The work on the Northern Electric Railroad is progressing as rapidly as possible in this part of Sutter County, and a large force of men is employed. A passenger car is making regular trips from Marysville to Butte Slough, from where a temporary track is being laid to carry material and workmen to Meridian. The rails are now in place to half a mile east of town.

SAN FRANCISCO, CAL.—A double-track railroad to run through the Fort Mason military reservation and to connect with the Polk street line of the United Railroads is to be constructed as soon as permits have been granted by the War Department and the Board of Supervisors. The immediate object is to provide a means of transportation to and from the United States transport docks.

VANCOUVER, WASH.—August 29.—The incorporation of the Washington Electric Railway Company, at Salem, is followed by the announcement that a new electric line is to be built between this city and Tacoma. The place of business of the new company is given as Portland, and the capital stock as $1,000,000. It is understood that the Welsh interests, controlling the Washington-Oregon corporation of this city, are the real backers of the new line.

SEATTLE, WASH.—Reversal of the decisions made by Judge C. H. Hanford in the receivership case of the Seattle, Renton and Southern Railway by U. S. District Judge Ed. E. Cushman when he ordered the Federal receivers appointed by Judge Hanford discharged and decided that the Federal Court had no jurisdiction in the case. Judge Cushman sustained the petition of W. R. Crawford who was ousted from control of the street railway by Peabody, Houghteling & Company of Chicago last fall, that the case should be tried by the State Courts. Both Judge Hanford, who has since resigned, and Judge Rudkin of Spokane, had held that the Federal Court had jurisdiction.

SAN FRANCISCO, CAL.—At the annual meeting of the directors of the Central California Traction Company all of the officers and directors were re-elected, and Bertram E. Abrahamson was chosen a director to fill the vacancy created by the death of Ludwig Schwabacker. An interesting feature of the annual statement for the company was the announcement of a 30 per cent increase in the gross earnings over those of the preceding fiscal year. The officers of the Central California Traction are: Alden Anderson, president; Mortimer Fleishhacker, Herbert Fleishhacker and Geo. W. Peltier, vice-president; H. A. Mitchell, secretary and general manager, and Walter Arnstein, treasurer.

SAN FRANCISCO, CAL.—Plans and specifications for the construction of the overhead trolley system for the extension of the Geary street road from Kearny street to the outer Market street tracks at Sansome street, leading to the ferry, were filed with the Board of Works by City Engineer Marsden

Manson. Manson estimates that the cost of putting the trolley system in working order along the entire line from beach to ferry at $64,000. These plans assume that the trolley wires in Market street will be attached to the United Railroads' poles and overhead system. Specifications for track construction for the westerly extension were filed and referred to the public utilities committee. The cost is estimated at $81,750 for the route beginning at 33d avenue and Geary street, thence to Balboa street, 45th avenue and Cabrillo street to the Great Highway. The bonus is fixed at $150 a day with a 25-day limit. This gives the contractor a chance to earn $3750 extra and makes the total appropriation required $85,500.

OAKLAND, CAL.—For the purpose of constructing a solid pier in place of the present pile structure of the Key Route system the Oakland Terminal Company has issued $1,100,000 of 6 per cent collateral trust notes, maturing August 20, 1913. The bulk of the loan has been taken by a syndicate of San Francisco and Oakland financiers. Torrance, Marshall & Company (successors to J. H. Adams & Company), are offering $100,000 of the issue at par and interest. The notes are guaranteed by indorsement of the Oakland Railways Company and are a first lien on the property known as the Key Route Basin. The Anglo-California Trust Company is made trustee and holder. As additional security the following collateral: $1,843,000 Oakland Traction Company general consolidated 5s, due 1935; $1,413,000 S. F. O. & S. J. Consolidated Railway 5s, due 1938, together with 65 7-10 per cent of the outstanding stock of the San Francisco-Oakland Terminal Railroad Company, representing a controlling interest in what was commonly known as the Oakland Traction Company, the San Francisco, Oakland and San Jose Consolidated Railway (Key Route), the East Shore & Suburban Railway Company and the California Railway Company. One million dollars of this loan is to be deposited with the Union Trust Company, subject to withdrawal on engineers certificate only.

TELEGRAPH AND TELEPHONE.

ARLINGTON, WASH.—The South Fork Telephone Company has been organized and will build a rural line to serve that valley.

BAKER, ORE.—The people of Preston and Dennis are subscribing stock for a company to build a telephone, on which work will probably be started this fall.

LAS VEGAS, N. M.—Improvements that will greatly increase the efficiency of service of the Western Union Telegraph Company are now under way in the local office.

EL PASO, TEX.—The Tri-State Telephone Company has purchased the majority of the physical properties of the now defunct Southern Independent Company. The company is handicapped by lack of sufficient conduit and cable capacity.

OLYMPIA, WASH.—A petition signed by 100 citizens of Castle Rock, urging the consolidation of the two telephone companies operating in that city has been filed with the public service commission. Complaint is made on the ground of poor service.

SAN FRANCISCO, CAL.—O. L. Scott and C. W. Eastin, president and secretary of the Municipal Telephone and Anti-Merger League, have filed a petition with the Board of Supervisors asking that an election be called early in October for the purpose of voting $6,000,000 bonds for a municipal telephone system. Attention is called to the fact that some five months ago the people expressed themselves as favoring the proposition and that it is the duty of the Supervisors to call the election providing for a bond issue.

TRANSMISSION.

KELLOGG, IDAHO.—H. M. Ross, manager of the Nabob Mining Company, announces that a contract has been let with the Washington Power Company to install a power line to the property on Pine Creek. A 75 h.p. motor will be installed and a compressor developing 427 cubic feet of air a minute will be used.

LAPWAI, IDAHO.—The Lewiston-Clarkston Light & Power Company is considering the extension of its lines to the Lapwai valley.

NAPAVINE, WASH.—The Independent Electric Company has asked the County Commissioners at Chehalis for a franchise to operate a power line through this town for the purpose of supplying electricity.

SAN FRANCISCO, CAL.—The Great Western Power Company has filed with the Railroad Commission its answer to the complaint of the Pacific Telephone & Telegraph Company, which charged that the power company, by induction of its lines, had seriously injured the usefulness of the telephone lines. The power company, in reply, declares that if the telephone company's contentions were upheld no power company would be able to maintain a line within 1500 feet of a 'phone line, and that it would be impracticable under such conditions for electric corporations to distribute power in accordance with the requirements of the population.

SAN BERNARDINO, CAL.—The construction work on the building for the second unit of the big steam plant of the Southern Sierras Power Company, in this city, is practically completed, and the machinery is now being installed. The boilers are being put in place, but the plant will be delayed for operation until the arrival of the big turbine, which will not be here for several weeks, it is expected. The early completion of the plant is desired, as it will be called on to furnish juice for the desert sections as far north as Randsburg until the through line from Bishop is ready for operation. Relative to the situation on the desert as to construction work of the high power line, the Randsburg Miner says: The work of stringing the cables is now practically completed to the foot of the mountains north of Randsburg. The early supply of power now depends upon the completion of the substation here, as the current will be furnished from the subsidiary steam plant at San Bernardino until such time as the line can be finished into Bishop. Owing to certain complications about right of way over the aqueduct land in Inyo County, it may be a long time before the power plant near Bishop becomes available.

GILROY, CAL.—The Coast Counties Gas & Electric Company has filed with the Railroad Commission its answer to the complaint recently brought by the Pacific Telephone & Telegraph Company. The telephone company complained that the power company was constructing a high-tension power line in Santa Clara County near Gilroy which would seriously interfere with the telephone service. It requested the Commission to compel the power company to move its line to a distance of 1850 feet from the telephone wires. In its answer the Coast Counties Company states that its line has been in operation in the vicinity of Gilroy since July 1, 1912, and that the telephone company has been able to continue the operation of its wires undisturbed. The power company states, further, that it has operated continuously for about five years a high-tension line charged with 22,000 volts between Santa Cruz and Watsonville in proximity to the telephone wires and that the telephone service has not been injuriously affected. It states also that it is using what is known as "the underground delta system, which gives the least inductive effect known to the art of electrical engineering." The power company states also that the transmission of electricity at a high potential is necessary in the State of California, and that if power companies were required to give way to telephone lines an extensive district throughout the State would remain unserved with electric power.

ALPHABETICAL INDEX TO ADVERTISERS

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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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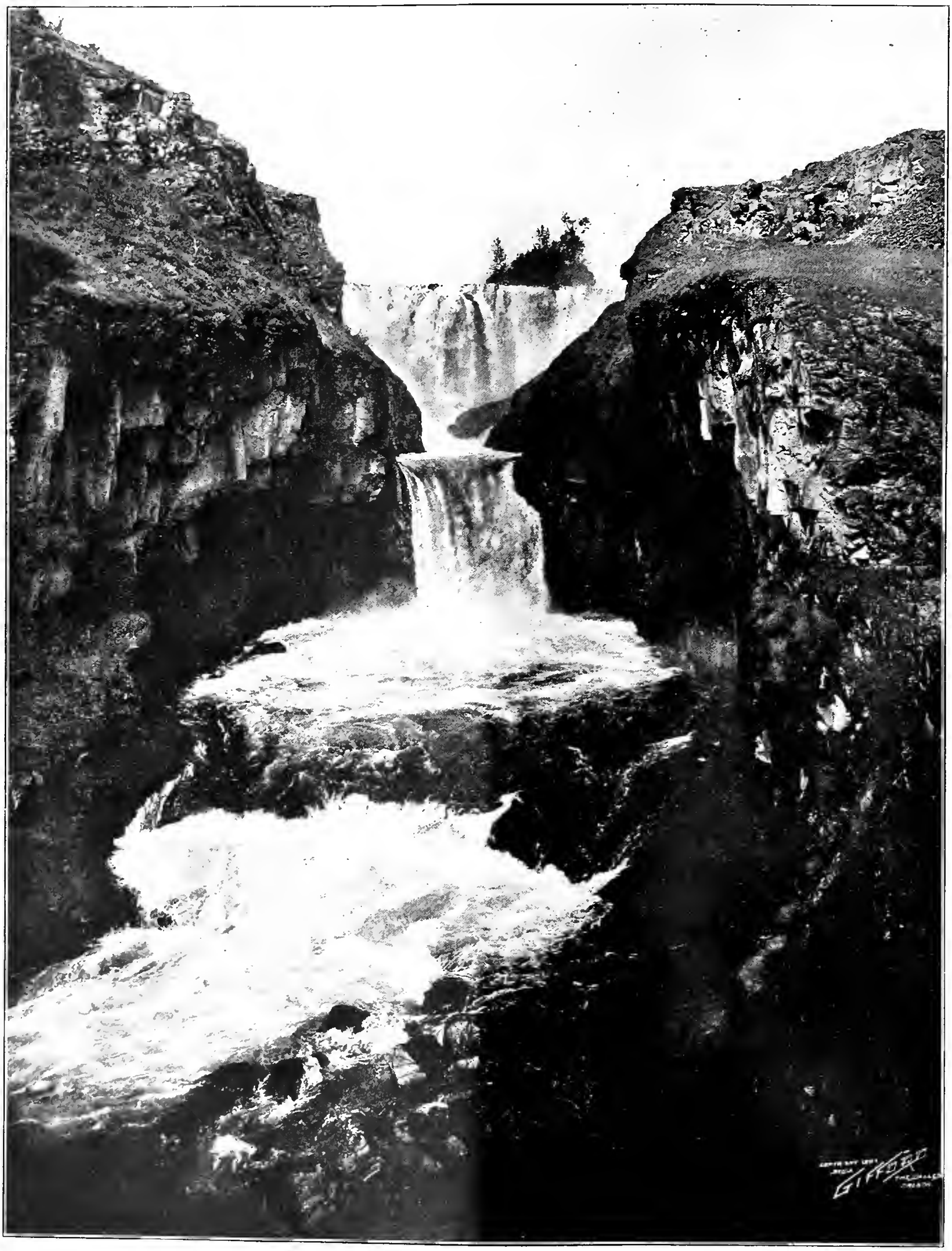


WHITE RIVER FALLS.

"Tumbling from its heights, it turns the wheels of industry."

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXIX   SAN FRANCISCO, SEPTEMBER 14, 1912   NUMBER 11

PACIFIC POWER AND LIGHT COMPANY

BY ARTHUR H. HALLORAN.

"Through the pathless forest."

ONE hundred years have witnessed many a change in that vast territory of "continuous woods where rolls the Oregon and hears no sound save its own dashings." Bryant's symbol of solitude in 1811 is now the home of half a million prosperous people. On the broad waters of the great Columbia is borne the commerce of the empire which fringes its banks, from its depths are drawn the salmon, tumbling from its heights it turns the wheels of industry, and now its very substance is being absorbed by thirsty lands to bring forth the fruits of the earth. At times of flood it has a greater flow than is attained by either the St Lawrence or the Mississippi; so great is its power that even the tides are overcome and its fresh waters extend ten miles out to sea.

Irrigation is the magic means whereby more changes have been wrought in this territory in the past decade than were accomplished in the preceding century and more since the Columbia was discovered in 1792 by Captain Robert Gray, the first man to carry the flag of the United States around the world. Waving grain fields, countless fruit trees and bustling towns now stand where once roamed the Indian ponies.

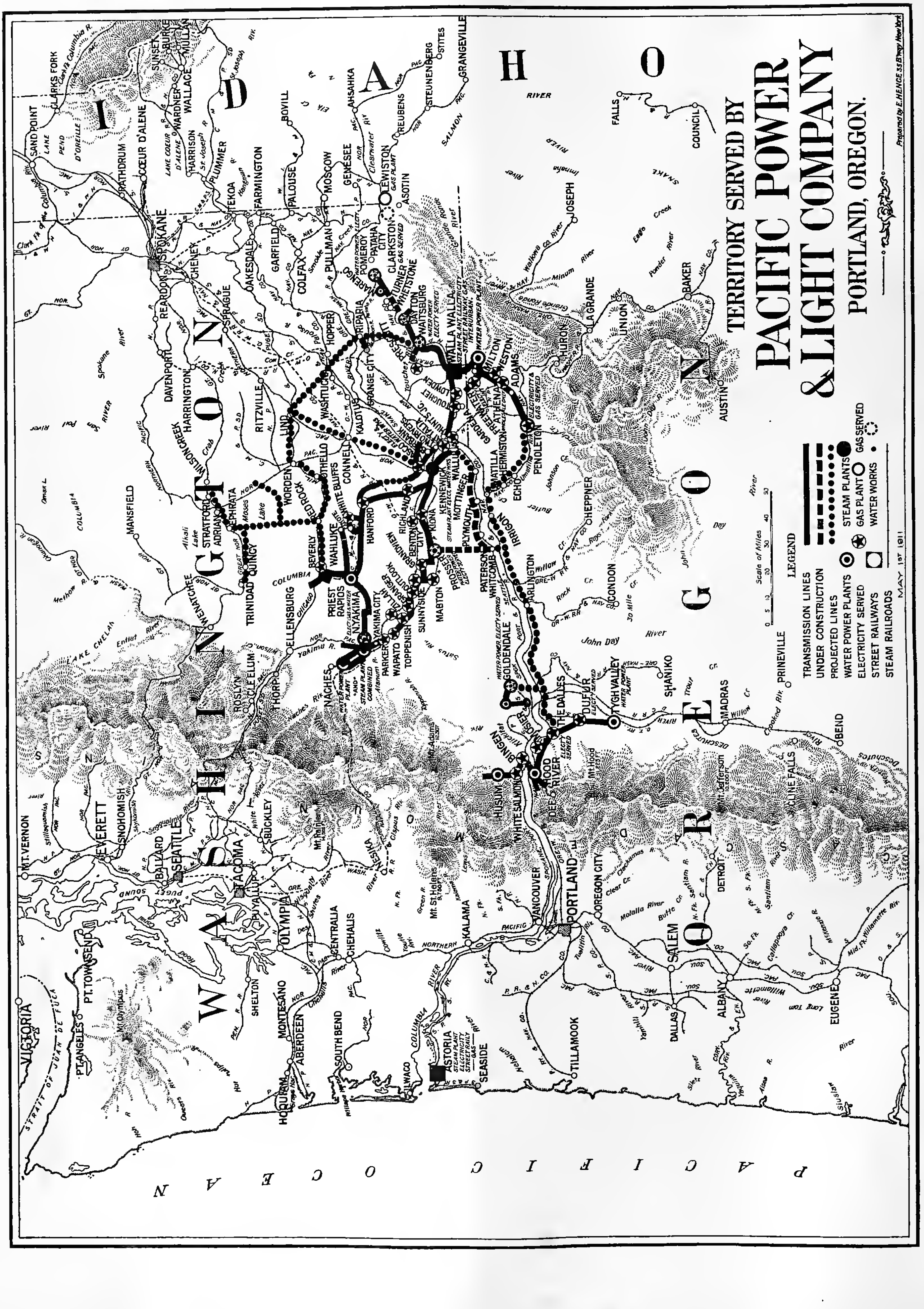
Electricity is the potent force by which even greater changes are yet to be made. Transmission line rights of way are being cleared in the pathless forests and across the rocky deserts. A net work of seven hundred miles of high tension transmission lines has already been constructed by the Pacific Power & Light Company to carry the power of the water-fall to the farmer's aid in wresting the treasure which lies hidden at the roots of every sage-brush in the great Columbia plateau.

Reference to the map of the territory served by the Pacific Power & Light Company shows that it comprises an area of about twenty thousand square miles in southern Washington and northern Oregon drained by the Columbia River and its tributaries. Only a small part of this vast region has yet been put under cultivation and based on the development of similar lands elsewhere the next few years should see a tremendous demand for power for pumping water to its arid but fertile soil.

The total generating capacity is 17,000 kw., of which 12,450 kw. are hydroelectric and 4550 kw. steam reserve. The plants are at Naches, North Yakima, Prosser, Kennewick, Marengo, Waitsburg, Walla Walla, Priest Rapids, White River, Husum, Goldendale and Astoria. Except for the last named all these plants will eventually feed into the transmission net work which already connects most of them. The main high tension transmission system is in the form of a ring of 350 miles of 66,000 volt lines which is fed by six generating plants. There are also 125 miles of 22,500 volt lines and 250 miles of 6600 volt lines, exclusive of city distributing systems.

The company also operates gas plants at Lewiston, Idaho, Walla Walla and North Yakima, Wash., Pendleton and Astoria, Oregon. It handles the street and interurban railways at Astoria and Walla Walla, and supplies water to North Yakima, Prosser, Kennewick and Pasco, Wash.

While much of engineering interest centers in the historic development of the several component plants and the manner in which they have been welded into a great transmission system, an even greater human interest is interwoven with the beneficient utilization of electric power in the reclamation of this rich empire long regarded as a desert unblessed by God and undesired by man. This region, where none but the daring came and none but the strong survived, is now peopled by a sturdy race and supplying its full quota to the world's markets.


TERRITORY SERVED BY
PACIFIC POWER
& LIGHT COMPANY
PORTLAND, OREGON.
LEGEND
TRANSMISSION LINES
UNDER CONSTRUCTION
PROJECTED LINES
WATER POWER PLANTS
ELECTRICITY SERVED
STREET RAILWAYS
STEAM RAILROADS
STEAM PLANTS
GAS PLANT
WATER WORKS
GAS SERVED
Scale of Miles
MAY 1ST 1911
WASHINGTON
IDAHO
OREGON
PACIFIC OCEAN

Yakima Division.

Naches Penstock.

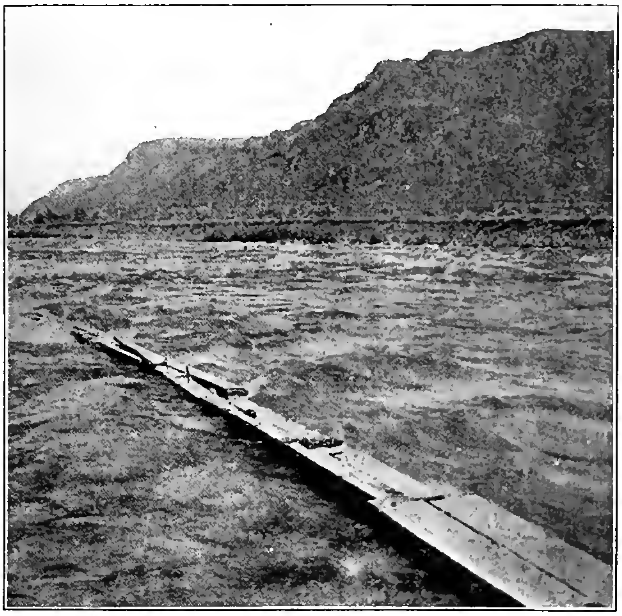
THE Yakima River flows in a southeasterly direction through central Washington from the Cascade Mountains to a junction with the Columbia River eight miles above Pasco and four miles above the mouth of the Snake River. Its fertile valley originally was the home of the Yakima Indians, whose language is perpetuated in the names of many of the towns and whose present reservation occupies its westerly portion.

Intensive agriculture by means of irrigation has rendered necessary the development of electrical power, not only for pumping but also to supply the domestic and industrial needs of the people living on the 200,000 acres which are now under water from the governmental and private canals. New projects are also under way or prospective by which the United States Reclamation Service proposes to more than double the present irrigated area of the Yakima Valley.

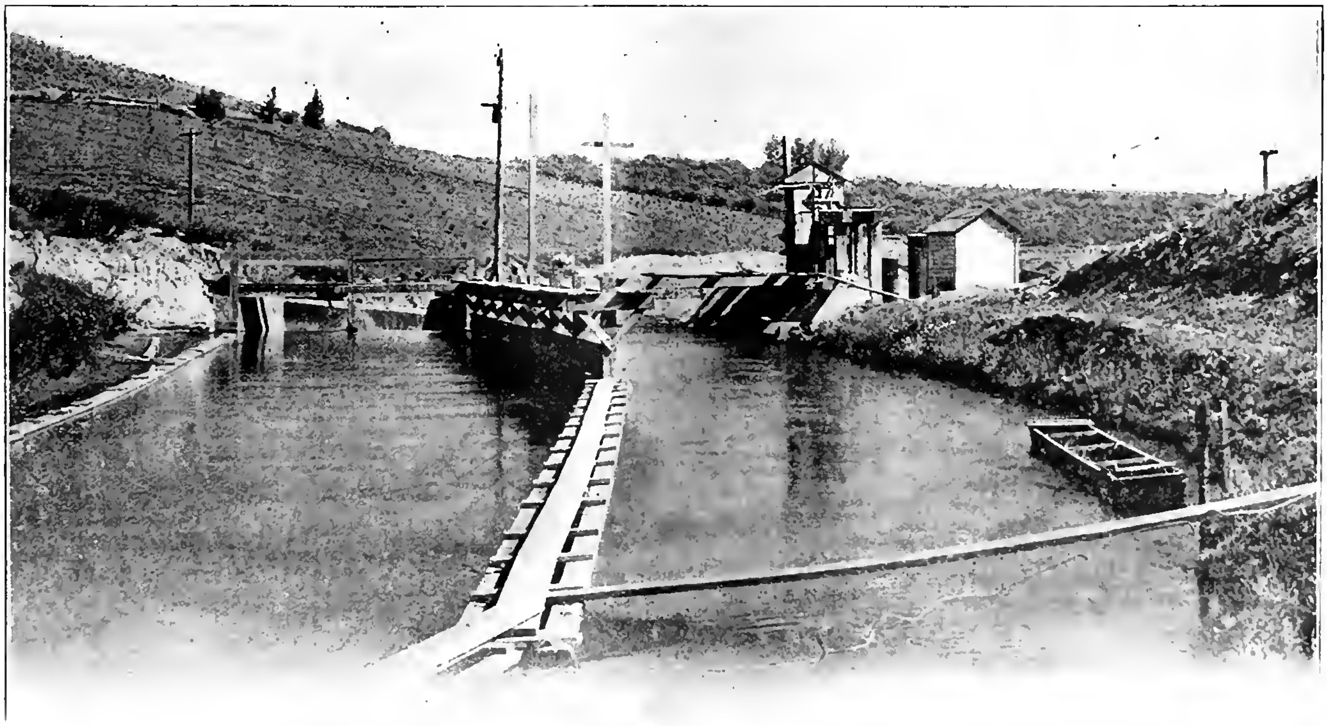
Electric power is generated by the Pacific Power & Light Company by a combined water and steam power plant at Naches, two steam power plants at North Yakima, as well as steam plants at Prosser and Kennewick. These properties were purchased during 1910 and 1911 from various companies and interconnected by transmission lines.

The Naches power plant is a 5750 kw. combined hydroelectric and steam generating station on the Naches River 13 miles west of North Yakima. The building is a substantial rubble-faced sandstone structure with concrete floor, wooden roof trusses and corrugated iron gable roof. The turbine room is 49x96 ft. and the boiler room 46x68 ft., there also being a corrugated iron boiler house addition.

Water is diverted from the Naches River by means of a 150 ft. concrete wing dam to eight miles of open canal leading to a small forebay above the



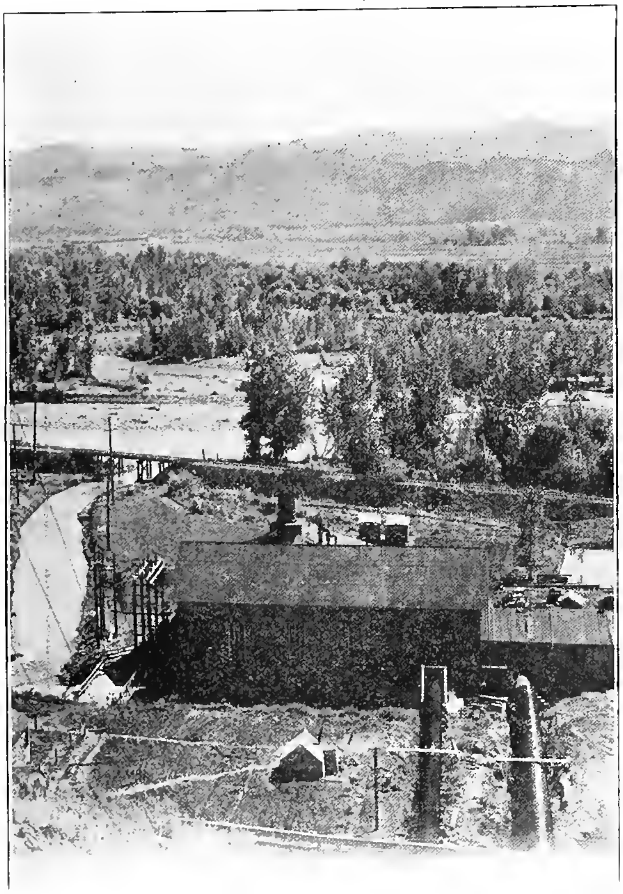
Naches Diversion.



Forebay and Head Gates at Naches Power Plant.

power house. The major portion of the canal is excavated in earth with 18 ft. bottom and 6 ft. depth, the 10 ft. banks sloping 1 to 1. This represents an excavation of 8 cu. yds. per lineal ft., gives a cross section of 216 sq. ft. and a capacity of 450 sec. ft. By decreasing the present grade of 2.6 ft. per mile and eliminating two falls in its course 69 ft. greater head can be gained. A lining of 2 in. plank was necessary for 6000 ft. of its length, an 8 in. cement core wall for 1760 ft. and a timber-lined tunnel for 140 ft.

The forebay is at an elevation of 150 ft. above the power house and consists of an enlargement of the last 300 ft. of the canal to a bottom width of 46 ft., the excavation being to bed-rock. At the lower end is a 12 in. cement wall through which two wood



Naches Power Plant.

stave penstocks lead to the turbines. These penstocks are of 6 ft. and 4 ft. diameter respectively and each is 537 ft. long being supported on concrete piers with steel elbows at the crest of the hill.

The wheels operate under a head of 149 ft., one being a Pelton impulse wheel, the other a Pelton-Francis turbine. The former is direct connected through a clutch to a 750 kw., 2300 volt, 60 cycle, General Electric three-phase alternator which is also connected to an 800 h.p. McEwen engine. The latter drives a 3000 kw., 2300 volt General Electric generator furnishing three-phase current at 60 cycles. An innovation in this plant is the steam-jacketing of the impulse wheel nozzles to prevent freezing of the water. The steam reserves are necessary on account of the liability of the water freezing in the ditch during the winter.

A third 2000 kw. General Electric alternator is driven by a Curtis turbine equipped with a 24 in. rectangular jet Wheeler condenser complete with motor driven centrifugal pump and steam driven dry vacuum pump.

Excitation current is supplied by three 125 volt General Electric dynamos, respectively turbine driven, mounted on alternator shaft and belt driven from induction motor.

Steam is supplied at 160 lb. pressure by two 375 h.p. and one 504 h.p. Stirling boilers, one 400 h.p. Babcock & Wilcox, and one 400 h.p. Geary water tube boiler. The three former are equipped with Kelly shaking grates and forced draft apparatus.

The switchboard consists of three generator panels, a transformer panel, a feeder panel, three exciter panels, and station panels, all equipped with General Electric instruments, including a Tirrill regulator. All panels are of blue Vermont marble.

Voltage is raised from 2300 to 66,000 by three 1500 kw. single-phase General Electric transformers with one spare, and to 22,500 by three 400 kw. Allis-Chalmers transformers, all water-cooled. High tension switching is accomplished through automatic Form K-12 hand-operated oil switches and single-pole, single-throw disconnecting switches. The 66,000 volt lines are protected by aluminum cell electrolytic lightning arresters on a Y-connected ungrounded circuit and the 22,500 volt lines by General Electric multi-gap carbon arresters.

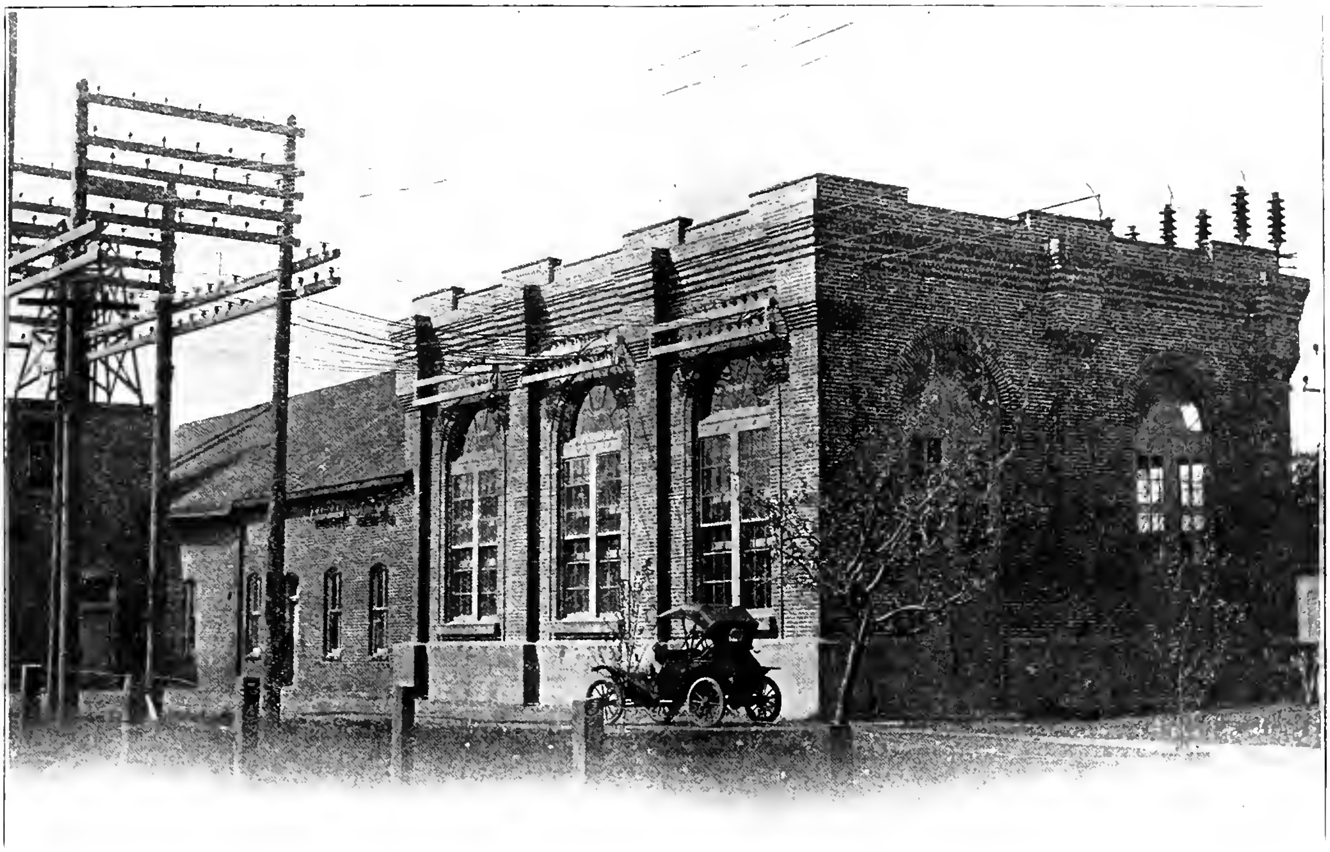
The 66,000 volt Naches-North Yakima transmission is a 15 mile pole line across a sandy and rocky country covered with sage brush. This line connects with the North Yakima-Black Rock 66,000 volt line through the substation at North Yakima and through disconnecting switches with the 66,000 volt line running from Kennewick through North Yakima. The insulators are pin-type and the conductor 66,370 c.m. aluminum.

The Naches-North Yakima 22,500 volt line feeds the Yakima Valley Transportation Company's substation near North Yakima. The conductor is 66,370 c.m. 7-strand aluminum cable.

The North Yakima station is a combined power plant, waterworks and substation. The two former are housed in an imposing building with brick masonry walls, concrete floor, wooden roof trusses and corrugated iron and tar and gravel roof. The generating and pumping room is 40x116 ft., the engine room 22 ft. square and the boiler room 27x42 ft. The substation is a brick annex at the north end of the plant.

This plant is equipped with a 350 kw., 2300 volt General Electric alternator direct connected by clutches to a 20 in. and 36x36 in. Allis vertical tandem compound condensing engine and to the water wheels, a 500 h.p. double 24 in. Stillwell Bierce horizontal turbine operating at 300 r. p. m. under 39 ft. head and a 250 h.p. single similar unit. Steam is supplied at 250 lb. pressure by two 125 h.p. Moran horizontal return tubular boilers, 72 in. diameter and 16 ft long. Steam is condensed by a 10 in. Baragwanath barometric jet condenser.

The waterworks pumping plant comprises two 10x12 in. belt driven duplex double-acting Holly

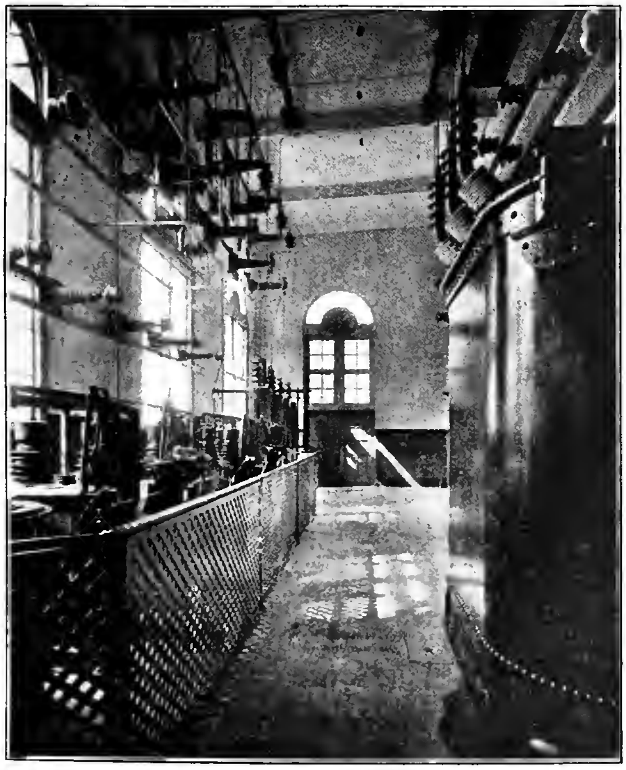


North Yakima Substation.

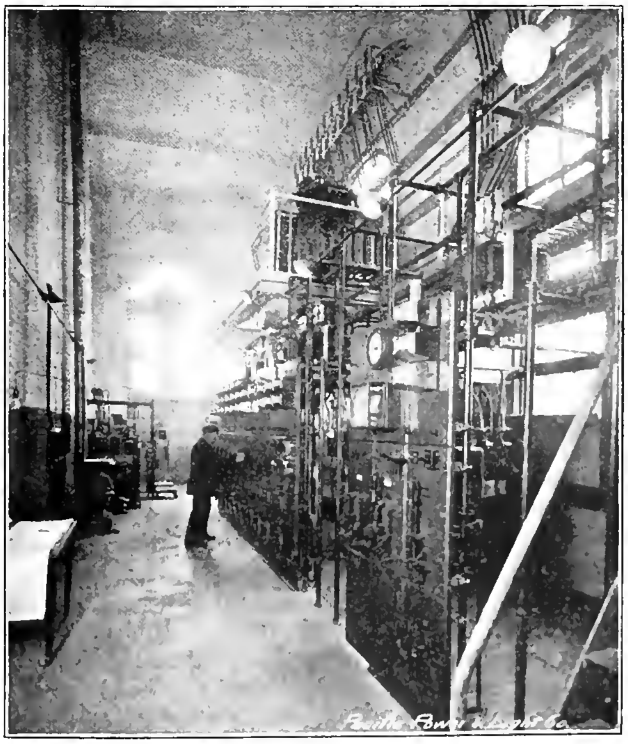
pumps, two 8 in. belt driven rotary Rumsey pumps and one motor driven three-stage centrifugal pump.

In the substation is a 2000 kw. three-phase 66,000/2300 volt General Electric transformer water-cooled, two 70,000 volt K-10 oil switches, one 70,000 volt aluminum cell lightning arrester protecting the transmission line running through the Yakima Valley and one 100 kw. motor-operated 2200 volt I. R. T. feeder regulator controlling the lighting circuits of the city of North Yakima. There are also three tub-type transformers for city arc lighting.

Power is distributed throughout North Yakima



Transformer Room in North Yakima Substation.



Switchboard and High Tension Switching Apparatus.

at 110 and 220 volts. The line construction is of the highest grade, being uniform throughout and put up under standard specifications. The alley construction is particularly pleasing in appearance, consisting of two poles, one set on each side of the alley, with two cross-arms connecting.

In addition to the power used for pumping the city's water supply, 15 h.p. supplied to the refrigerating plant of the Pacific Fruit & Produce Company, and that used for lighting, current is also supplied to the Yakima Valley Transportation Company, which operates about 20 miles of urban and interurban track, comprising 9 miles in North Yakima, 2½ miles to Fruitvale and 10 miles to Ahtanum. About twelve miles more are under construction and the system will eventually comprise about a hundred miles of interurban railway.

North Yakima is the hub of five rich farming valleys, apples, hops and potatoes being the principal crops. Irrigation by electric pumping is yearly increasing in importance, it being estimated that 15 h.p is required for every 120 acres of land at an approximate lift of 150 ft. Illustrative of this are the two pumping plants of the Central Washington Investment & Power Company at Terrace Heights, two miles north of North Yakima. No. 2 plant has two 50 h.p. three-phase motors direct connected to 5 in. Worthington centrifugal pumps lifting 700 gallons per minute 150 ft. No. 1 Plant has two 40 h.p. motors driving centrifugal pumps. Power is sold on the basis of $5.45 per h.p. of maximum demand, the irrigated land being worth from $1000 to $3000 per acre. In the Yakima valley the Pacific Power & Light Company has an irrigating pumping load of nearly 5000 h.p., there being about 250 pumping installations. The charge ranges from $30 to $42 per horsepower for the season.

From North Yakima there are two 66,000 volt transmission lines, one leading easterly through 26 miles of the Moxee Valley to Black Rock, whence connection is made with the line to the Priest Rapids power house, the other running southwesterly through the Yakima Valley 115 miles to Pasco by way of Wapoto, Toppenish, Zillah, Granger, Outlook, Sunnyside, Mabton, Grandview, Prosser, Benton City, Kiona, Richland and Kennewick. There is also a tie line from Richland to Hanford.

Black Rock 66,000 volt transmission line for the first 3½ miles of its length is an adaptation of the old 6600 volt line to the Central Washington Irrigation Company's substation at Moxee, a wooden frame corrugated iron structure housing a 150 kw. transformer stepping from 66,000 down to 6600 volts for distribution of three-phase current throughout the adjacent territory. The reconstructed section of the line is of 211,950 c.m. stranded aluminum, the balance No. 00 7-strand copper; all power conductors being carried on No. 4000 Thomas porcelain insulators. A telephone circuit of No. 8 solid copper is carried on a short arm beneath the power circuit. The substations at Black Rock are similar to that at Moxee, containing a 200 kw., air-cooled transformer with single panel switchboard, disconnecting switches and choke coils. The tie pole line from Black Rock to the Priest Rapids 66,000 volt line is 211,950 c.m. aluminum carried on No. 1090 Thomas suspension insulators, with a telephone circuit of No. 8 copper-clad wire.

The North Yakima-Pasco 66,000 volt line extends through the great governmental and private irrigation projects in the Yakima Valley. It joins the Naches-North Yakima line through disconnecting switches at North Yakima and the Walla Walla-Pasco line through the synchronizing station at Kennewick. Each of the principal substations is the center of a rich agricultural development, an oasis of ever-increasing size.

The Toppenish substation is conveniently situated to supply consumers in the Wapato and part of the Sunnyside projects. The station is a new brick building 66x25 ft., which houses the offices and local manager's apartments as well as the transforming equipment, three type H, form R.P., 60 cycle General Electric 66,000-6600/2300 volt, three 50 kw. 6600-2300 volt and two 2 kw. 6600-110 volt transformers, together with four-panel switchboard, motor-operated regulator, disconnecting switches and lightning arresters. The substation is about 1800 ft. from the main high tension line, being connected by a 66,000 volt branch circuit.


Toppenish Substation.

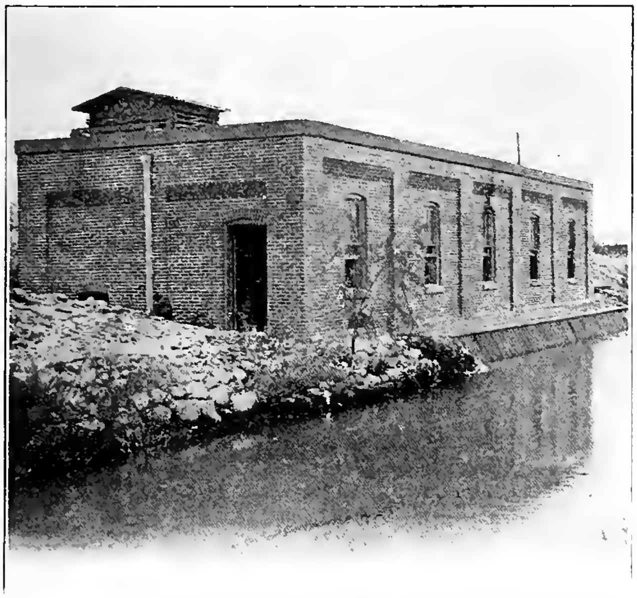
The Wapato project takes its name from the Indian wapato, a tuberous plant growing in marshy places and used as food by the Indians. This unit is a gravity canal system constructed by the Indians with tribal funds under Federal supervision. It already irrigates about 15,000 acres in the Yakima reservation, and will finally care for 116,000 acres with a storage capacity of 200,000 acre-feet. Ultimately, of course, this reservation will be opened for settlement. The town of Wapato, ten miles from Toppenish, is served by a three phase 6600 volt feeder circuit carried on a secondary cross arm on the poles of the main 66,000 volt line.

From the Toppenish substation 15.73 miles of three phase 6600 volt circuit also runs to serve irrigation consumers near Zillah, which town is included in the Sunnyside project.

The Sunnyside substation supplies most of the towns in the great government Sunnyside project which irrigates about 100,000 acres by means of 62 miles of gravity canal which delivers about 1200 second feet. These towns include Sunnyside, Granger, Grandview, Mabton and Prosser, the shipping points for thousands of carloads of apples and other fruits,

as well as the forage, hops and vegetables, for which this district is famous.

The Sunnyside substation is a brick fireproof building 25 ft. square, equipped with a 500 kw., three phase, water-cooled 38,150-66,000/6600 volt General Electric transformer, 5 panel switchboard, regulator and aluminum cell lightning arresters; 10.2 miles of 6600 volt, 3 phase distributing line has been built from the substation at Sunnyside to the town of Granger, Wash. This circuit is carried on a secondary cross arm bolted to the poles of the 66,000 volt transmission line running up the Yakima Valley. There has also been constructed a 6600/110 volt distributing system in the town of Granger.

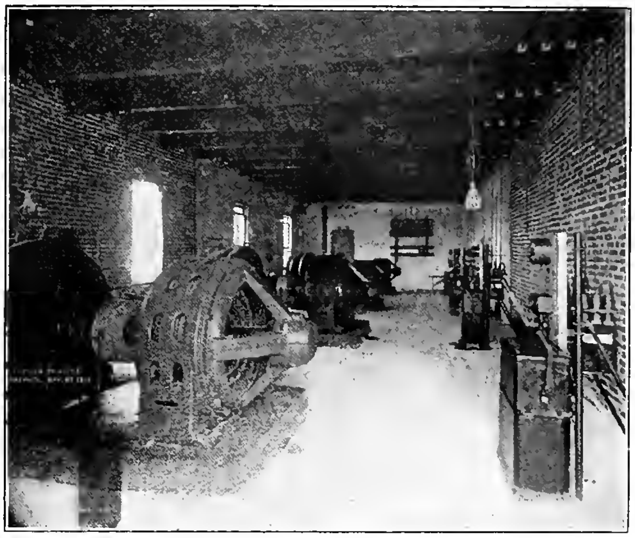


Exterior of N. P. I. Pumping Plant.

A three phase feeder line has been run from the substation at Sunnyside to the town of Grandview, Wash. This circuit is carried on a cross arm placed beneath the present 66,000 volt transmission line running past Sunnyside and Grandview. The former 66,000 volt branch line to Mabton which was tapped off the high tension line near Grandview has been disconnected from the main high tension line, and now feeds Mabton at 6600 volts, having been tapped onto the 6600 volt circuit which feeds Grandview from Sunnyside. The construction of this branch line to Mabton remains unchanged. A 6600/110 volt distributing systems have been installed in the towns of Mabton and Grandview.

At Prosser is a combined water and steam auxiliary power plant, 73x54 ft., and transformer house 40x38 ft., formerly belonging to the Prosser Falls Land & Power Company. Water is diverted to a 12x12 ft. flume from the Yakima River above Prosser Falls by means of a 516 ft. concrete dam 6 ft. high which is also used as a footing on which is erected a 7 ft. flash-board used during the summer to create a reservoir 9 miles long, averaging 600 ft. wide, giving a storage capacity of about 3800 acre feet. There are two water wheel generating units, a 56 in. Samson turbine with Woodward governor operating through bevel gears a line shaft to which is belted a 400 kw. General Electric 2300 volt, 60 cycle, three phase generator, and a double 48 in. vertical Victor turbine bevel-beared to a line shaft which is belted to a 200 kw., 2300 volt, 60 cycle General Electric alternator with self-contained exciter. A 12 kw., 125 volt exciter is belt driven from the shaft of the 400 kw. generator. The auxiliary steam equipment includes a 90 h.p. Erie tubular boiler and Watertown engine together with feed water heater and barometric condenser.

The Prosser substation has three 200 kw. General Electric type H transformers, 66,000Y-2300/6600 volt; with the usual lightning protection and switching equipment.



Interior of N. P. I. Pumping Plant.

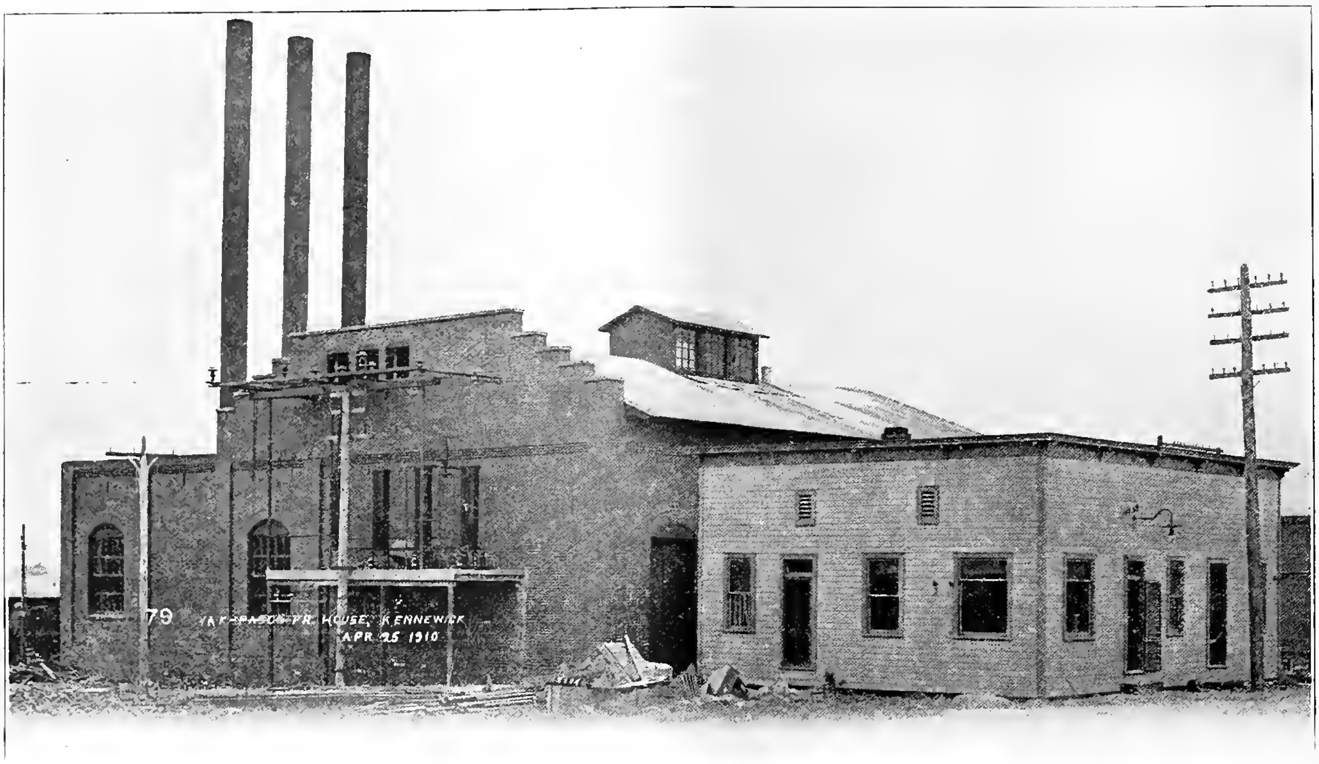
At Benton City a 150 kw. transformer equipment steps the power down to 6600 volts for distribution to a number of irrigation and power consumers in the vicinity, there being about 2¼ miles of distributing line.

At Richland is a 200 kw. substation where the Hanford line is tied in with that of North Yakima. In the immediate vicinity about 14½ miles of 6600 volt feeder circuits have been constructed to supply irrigation customers, the greater part of this distribution system being carried on a separate cross arm placed on the poles of the 66,000 volt line to Hanford.

The Northern Pacific Irrigation Company's substation consists of a substantial brick building 20x17 ft., with walls 25 ft. high from bottom of footings to top of parapet. The roof is a 4 in. reinforced concrete slab carried on steel beams and the floor is 6 in. concrete slot laid on the earth and reinforced with ⅜ in. round iron 12 in. centers laid both ways. The building is furnished with wooden frame doors and windows and with galvanized iron ventilators in roof.

This substation is near the company's pumping plant near Kennewick. The equipment includes one 1000 kw., 66,000/2300 volt, G. E., 3 phase, water-cooled transformer, with disconnecting switches and 200 ampere double helix choke coils mounted on insulators.

The Kennewick power plant is situated near the business center of the town and occupies a well designed building with brick masonry walls, concrete floor, wood and steel roof trusses, and asbestos covered roofing. The prime mover is a vertical Curtis steam turbine driving a 500 kw., 2300 volt General



Kenniwick Substation and Steam Power Plant.

Electric alternator at 1800 r.p.m. Exciting current is furnished by a 25 kw. Curtis turbo-generator and steam is supplied by three 150 h.p. Atlas horizontal return tubular boilers and one 150 h.p. Keeler water tube boiler. Roslyn coal is used as fuel.

Water for the jet condenser is pumped from a 30 ft. well on the premises and discharged to the river through 2300 ft. of 12 in. machine wound wood-stave pipe and 200 ft. of 14 in. wrought iron pipe. A 450 h.p. No. 2 Stickle open coil heater and purifier handles the boiler feed water.

A 13-panel switchboard with swinging synchronizer bracket stands on the generator floor in front of a 1000 kw., three phase, 38,150-66,000/2300 volt transformer. Two General Electric K-10 66,000 volt oil switches stand on a gallery above the transformer, the disconnecting switches and lightning arrester being mounted on the wall to the rear. The 1250 volt, 6.6 ampere arc lighting system is cared for by a 25-light constant current regulator installed in the station.

The Pacific Power & Light Company operates the pumping plant which supplies water to Kennewick. The pumping station is a wooden frame building 10x12 ft. housing a 7x8 in. class D Smith Vaile triplex pump belted to a 20 h.p., 3 phase, 220 volt Westinghouse CCL induction motor and a three-stage 4 in. Kingsford pump direct connected to a similar 40 h.p. motor.

The Kennewick station is near the center of the system and does most of the governing. Here is the load dispatcher's office and a 500 kw. turbine floating on the line ready at a moment's notice to pick up the load.

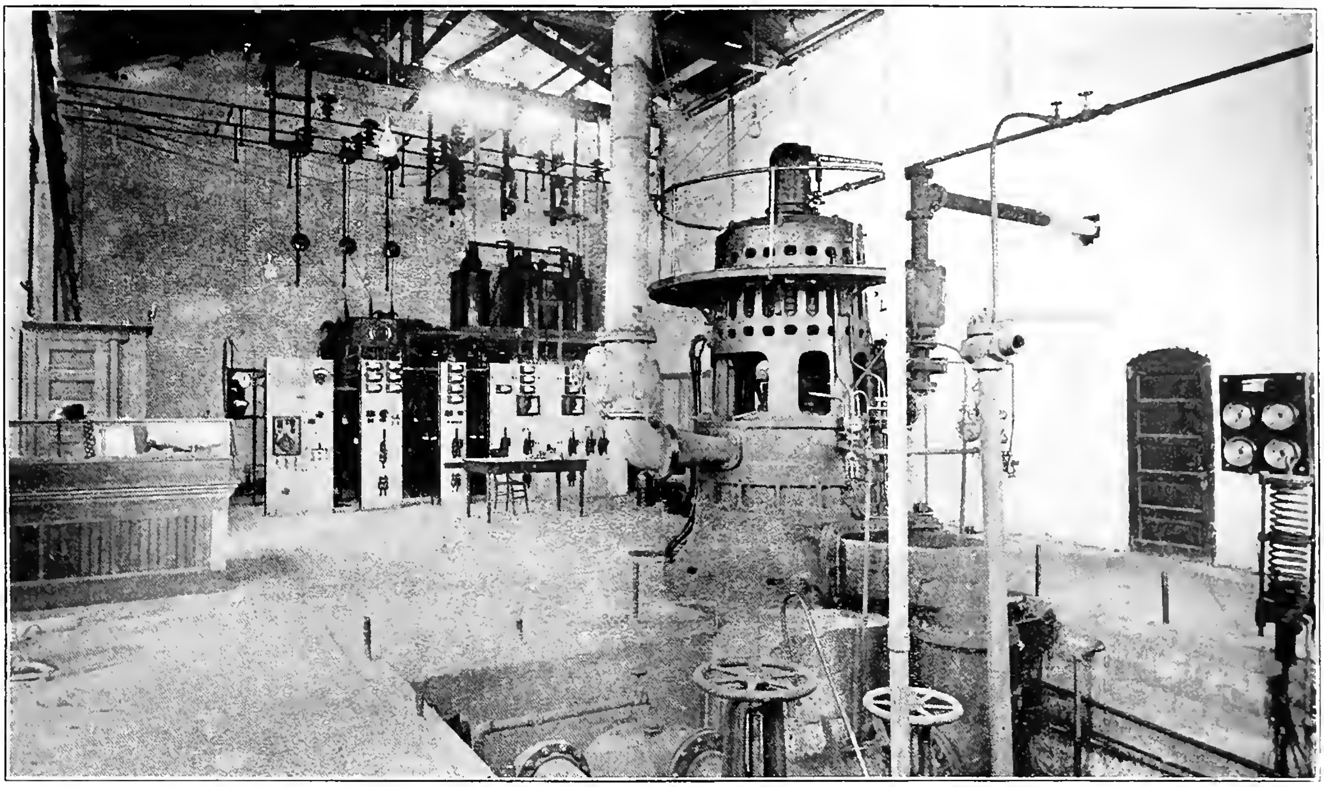
Kennewick is directly across the river from Pasco, these towns being the chief points of navigation on the upper Columbia River. The 66,000 volt transmission line is carried across the river here by means of three steel towers, one 146 ft. tower on either bank and one on an island. One span is 1191 ft., the other 1677 ft. The conductor is 250,000 c.m. stranded aluminum cable. The crossing is provided with a ground wire of ¾ in. steel cable strung across centers of towers, this cable being bridled at each end to two anchor cables which run back to the ground.

This line continues 46.1 miles to Walla Walla, serving as a tie between the Yakima Valley, the Upper Columbia and the Walla Walla systems. Power is transmitted in either direction, thus permitting full utilization of all power generated at either of the systems. The Snake River is crossed at Burbank by a 1652 ft. span carried by two 135 ft. steel main towers and two 35 ft. anchor towers. The conductor at the crossing is ½ in., 7-strand, copper-clad steel wire. More than 13,500 acres have been reclaimed at Burbank by gravity canal from the Snake River.

The Pasco Reclamation Company is the largest single consumer at Pasco. This company has about seventeen thousand acres of irrigable land surrounding the town of Pasco and occupying the gore formed by the junction of the Columbia and Snake rivers. The maximum lift for pumping is 125 ft. during the month when irrigation is necessary. About half this area is now under water pumped from the Snake River.

The pumping plant is a concrete structure on the north bank of the Snake River two miles above its confluence with the Columbia and directly under the tracks of the Portland, Seattle and Spokane Railway. Three 250 kw. transformers lower from 66,000 to 2200 volts, at which voltage two General Electric induction motors, one 30 h.p., the other 35 h.p., are direct connected to two single stage vertical Worthington pumps 40 ft. below.

A heavy timber submerged intake, 4x6 ft., extends from the stream channel to the control gates. Each pump has a 16 in. suction and 14 in. discharge.



Interior of Kennewick Steam Plant.

The main discharge is through 900 ft. of 36 in. wood-stave pipe to the main distributing gravity canal, the upper portion of which is concrete lined. Concrete bays with wooden gates control admission to the distributing lines.

The distributing lines are all wood-stave pipe, the 24 in. and larger being built of continuous staves and smaller of machine banded. As a rule the system follows the subdivisional lines and is interconnected as far as possible, frequent valves being provided for cut-out. Blow-offs are provided at all depressions and stand-pipes at all summits. The use of wood-stave pipe, instead of open canals, conserves the water, reduces the cost of maintenance and gives a more permanent system.

Electric pumping here, as elsewhere, is fast displacing other forms on account of lower initial investment, maintenance, operation and depreciation. Each year sees fewer water wheels and gas engines and more electric motors.

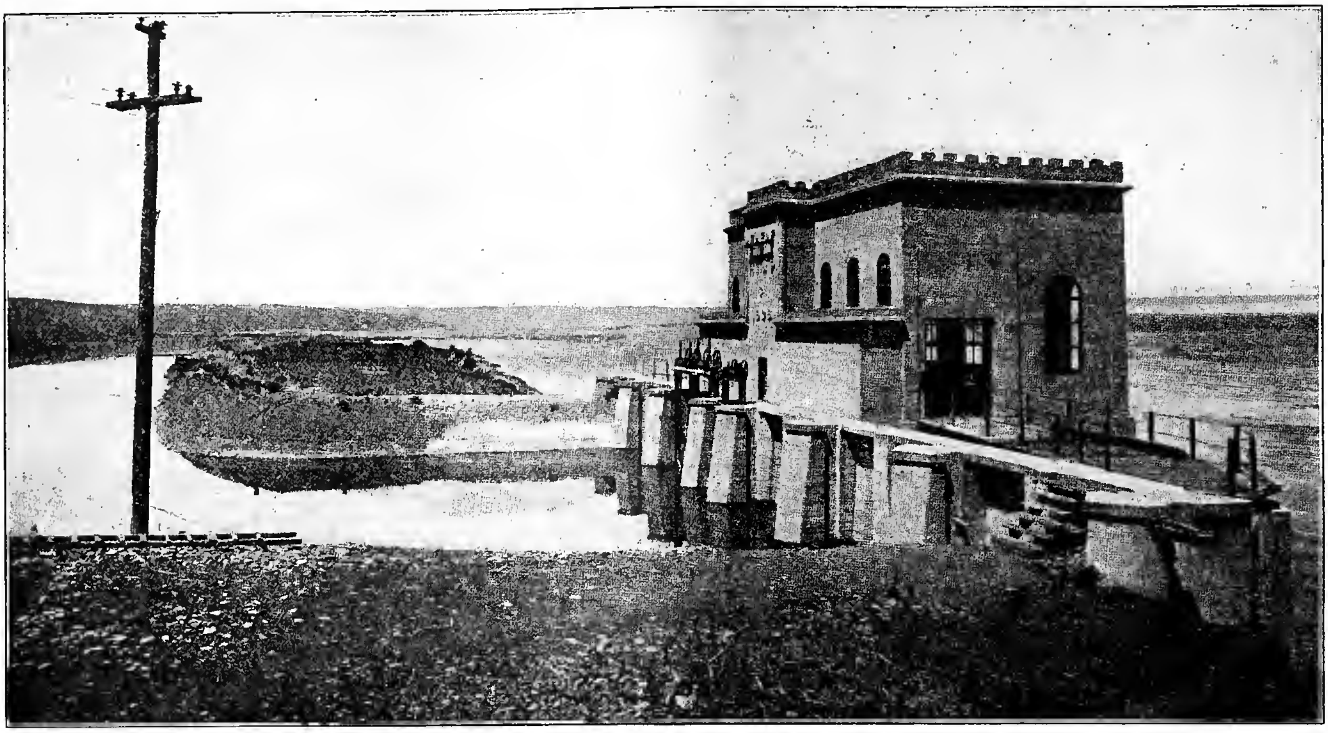
The soil throughout the region is rich and deep the barren appearance of much of the county being due to the scanty rainfall, averaging 9 inches at North Yakima, 6 inches at Sunnyside and 3 inches at Kennewick. The mean average temperature is close to 50 degrees, without very great extremes. Hay, alfalfa, wheat, oats, potatoes, hops, fruits and vegetables of all kinds are raised in abundance. The months of continuous sunshine during the long summer months admit of almost tropical luxuriance of growth wherever the necessary amount of moisture is supplied. All these lands were parts of a great lake bottom made up of disintegrated basaltic blocks and volcanic dust, which accounts for their great fertility.

Upper Columbia Division.

Although the country north and east of the Yakima Valley has the same rich soil and favorable climate, its comparative inaccessibility has retarded its development. The Benton project of the Reclamation Service proposes at some day to supply water to the lands on the west bank of the Columbia from Kennewick to Priest Rapids, but of far greater immediate

Irrigation Ditches, Near Hanford.

value is the extensive work of the Hanford Irrigation & Power Company, which has installed a large generating plant at Priest Rapids and transmits power to Hanford and Coyote Falls, where water is pumped to irrigate 16,000 acres. North of this development the Rose Land Company is also pumping by means of current transmitted from Priest Rapids to Beverly, where the new line of the Chicago, Milwaukee & Puget



Priest Raipds Power Plant.

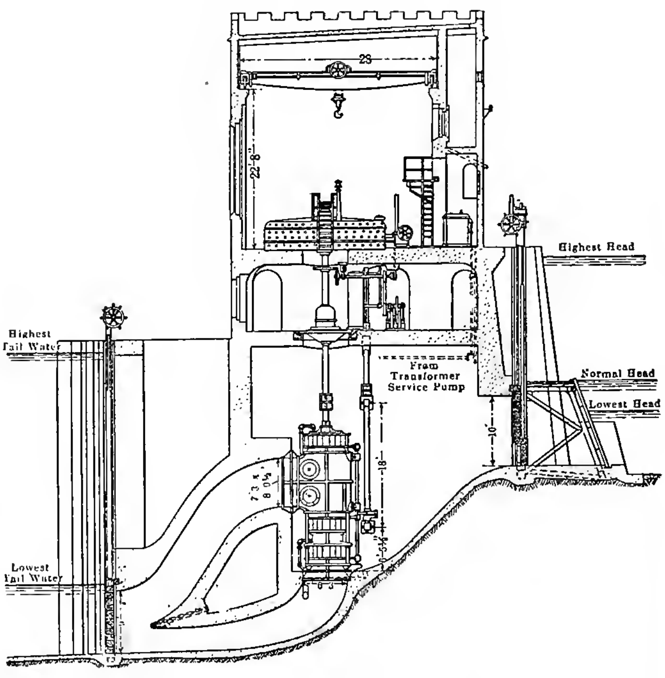
Sound railway crosses the Columbia. As this country is now rapidly developing it offers an excellent market for power.

The Priest Rapids development on the Columbia River east of Hanford was originally designed as a generating station from which power could be transmitted to various pumping plants along the Columbia and to the town of Hanford. With the affiliation of this company with the Pacific Power & Light Company this plant was tied in with the transmission lines of the latter.

An island separates the Columbia into two channels above Priest Rapids and made possible the construction of a wing dam across the south channel. This diverts a part of the water through an intake 140 ft. wide and 700 ft. long discharging into a natural lagoon which forms the first three-quarters of a mile of the conduit. At its lower end ten butterfly type gates control the water admission into 5000 ft. of canal which has been excavated to a bottom width of 67 ft., with sides sloping 1½ to 1. The earth and gravel from the excavation was used as a protective embankment for the entire length of the conduit which parallels the river.

The power house stands as an integral part of the dam at the end of the canal, the water discharging directly into the river after passing through the wheels. The head-race wall extends 50 ft. on each side of the building, thus allowing for future longitudinal extensions to accommodate four more units. As shown in the cross-sectional view of the power house the building has three floors. The upper carries the two generators, the middle the thrust bearings and the lower the turbines, all this floor being below the high water level of the river and 58 ft. below the generator floor. This was necessary on account of the variation be-

Head of Priest Rapids Power Canal.



Cross-Section of Priest Rapids Plant.

tween low and flood water which causes a head varying from 18 to 27 ft.

Each of the 900 kw., 60 cycle, 3 phase, 2200 volt, revolving field, vertical shaft, Bullock generators is driven through vertical shafting by a 1000 h.p. vertical Allis-Chalmers turbine in open flume, one being a single, the other a triplex. The latter consists of a twin center discharge turbine mounted on the same shaft above a single lower discharge turbine. The concrete draft tubes lead the water from both discharges with uniformly decreasing velocity to the tailrace, the lower draft tube being 11 ft. below the low water mark of the river. Tailrace gates are provided for each of the turbines, so that it is possible to pump out the pits for inspection and repair by means of a motor-driven bilge pump.

The two exciters are 60 kw. compound wound machines, one being driven by a 100 h.p. single runner turbine, the other by an 85 h.p. 2300 volt motor. The use of this motor-generator set instead of a second turbine driven exciter saved considerable space.

The switchboard stands on the generator floor in front of and on a level with the transformers, which are housed in a bay to the rear. The board consists of seven 16x90 in. black enameled slate panels, including two generator, two exciter, one induction motor, one transformer and one outgoing line panel.

The transformers consist of three 1000 kw. water-cooled delta connected units which raise the potential from 2200 up to 66,000 volts for transmission to Hanford and two 250 kw. units supplying 6600 volt current to the Beverly line.

The Priest Rapids-Beverly 66,000 volt transmission line runs from the Priest Rapids generating station in a northerly direction across the Columbia River to Beverly, Wash. It is 14.6 miles long and traverses a sandy and rolling country covered by sage brush. This line was operated for some months feeding the 66,000 volt substation at Beverly to serve the Rose Land Company and other customers on the west side of the Columbia River. In April, 1912, the Beverly transformers were cut out and the line voltage lowered to 6600 volts, feeding the customers direct from the Priest Rapids station at that voltage. The power conductors are No. 0000 aluminum from the power house to the main tower on the south river bank; from this tower to the main tower on the opposite bank conductors are 9/32 in. Siemens & Martin steel cable; the remaining portion through to Beverly is No. 0 copper. The Beverly substation contains one 300 kw., three phase transformer.

Beverly Substation.

The Priest Rapids-Hanford line is a reconstruction of the 23,000 volt line to the Coyote pumping plant, consisting of 40 ft. poles spaced 142½ ft. apart. The pole framing of this line was altered to make it suitable for 66,000 volt operation. The old cross arms, insulators, pins and power conductors were removed and returned to the Kennewick storeroom. Three new aluminum power conductors were run with a loop into the Coyote pumping plant and on to Hanford. The old telephone wires were transferred from the old brackets to R. Thomas telephone insulators placed on 5 ft. cross arms. The line has a surveyed length of 28.46 miles.

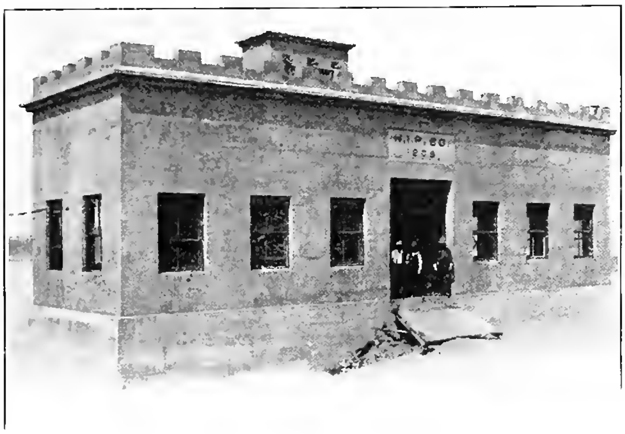
The Richland-Hanford line is a 66,000 volt, three phase transmission on wooden poles connecting the substation at Hanford, Wash., with the Yakima Valley 66,000 volt transmission line near Richland, Wash. On the same pole line there is carried a telephone circuit. A telephone circuit has been run from the Kennewick substation on the poles of the old Yakima Valley 66,000 volt transmission line to connect with the above mentioned telephone circuit. This Richland-Hanford line is by survey 26.2 miles long and is over a country sandy, rocky and in many places rough, and is also covered with sage brush.

The Coyote Rapids pumping station stands on the banks of the Columbia 16 miles below the Priest Rapids power house and pumps water under a 36 ft. head from the river. The building is of concrete construction, 67x25 ft. The present installation consists

Rear View Coyote Pumping Plant.

of three pumping units, with provision for more. On the upper floor are the three main pump motors, switchboards and transformers, on the lower are the pumps.

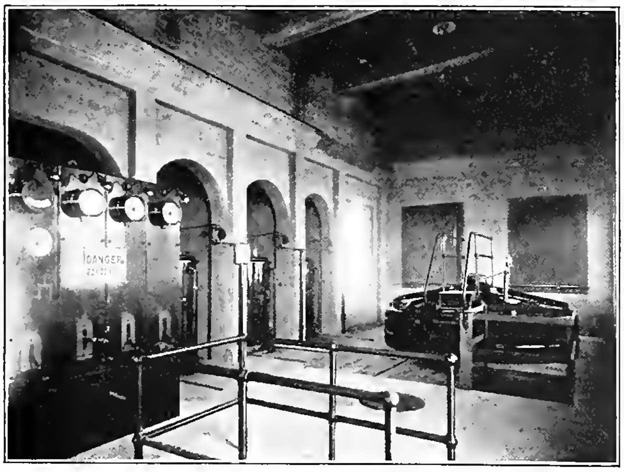
Incoming power is received at 66,000 volts through a concrete line tower on the roof, stepped down to 2200 volts by three 600 kw. transformers, and used to operate the motors, two 450 h.p. induction units and one 675 h.p. unit. The former are direct connected to Allis-Chalmers centrifugal pumps with single stage vertical shaft and the latter to a certrifugal pump manufactured by I. P. Morris Co.



Coyote Rapids Pumping Station.

A wooden intake tunnel 8 ft. high extends 300 ft. out into the river to the intake crib below the river's lowest water level. Thirty inch sluice gates are placed at the suction inlet of each pump. A bilge pump like that at the power house is used to empty the intake well and prime the main pumps.

Current for the pumping plant is supplied from a nearby wood frame substation housing three 600 kw.



Interior of Coyote Pumping Plant.

transformers Y connected on the 66,000 volt side and delta connected on the 2300 volt side. Three similar 333 kw. transformers feed a 15 mile wood pole line to White Bluffs, branch circuits supplying irrigation customers in the adjacent territory.

The Hanford substation and pumping plant, a building 30x23 ft., has been enlarged by the addition of a reinforced concrete structure 28x23 ft. which is used as a synchronizing station connecting the 66,000 volt lines from Priest Rapids to those from Richland. A 50 h.p. Allis-Chalmers, 2200 volt, three phase motor drives a Dean triplex pump having a capacity of 500 gallons per minute under 100 lb. pressure. Three 200 kw. transformers step down from 66,000 to 2200 volts. A synchronizing panel is included in the five panel switchboard.

Walla Walla Division.

Walla Walla, or "many waters," in the language of the Indians whom the adventurous settlers of 1818 found in this vicinity, has had a most interesting history in its evolution from a fur-trading headquarters to its present enviable position as the center of a rich agricultural valley whose five million acres are contained within the boundaries of the Columbia on the north, the Snake on the west and the Blue Mountains on the east and south. Of particular engineering historic interest is the fact that it was the site of the pioneer experiments with single phase transmission of hydroelectric power.

In 1892 the Walla Walla Gas & Electric Company harnessed the power of Mill Creek, five miles east of Walla Walla to operate a double-nozzle Pelton wheel driving a 100 kw., 133 cycle, single phase generator of the old composite wound Thomson-Houston "A 100" type. This generator delivered power at 2000 volts directly to a single circuit of No. 0 copper wire leading to the substation at Walla Walla. Here a similar generator was used as a synchronous motor to drive the line shafting to which were belted the several dynamos furnishing current for the arc and incandescent lighting of the town. This shafting was also driven by a 100 h.p. Ball tandem compound engine which had been installed in 1890. The incandescent lighting load was mainly cared for by the transmission line, the steam plant being used as an auxiliary.

One of the most interesting features of this equipment was the method of starting. A 15 kw., 500 volt exciter for the generating unit at the hydroelectric plant was first thrown on the line and used to drive a 7½ kw., direct current, bi-polar starting motor in the Walla Walla substation which brought the 2000 volt synchronous motor up to speed. When this was accomplished a 1½ kw., 110 volt exciter was thrown on to the field of the synchronous motor, the 500 volt, d.c. generator cut off the transmission line and the 2000 volt generator thrown on. These various maneuvers were accomplished by means of double throw, double pole switches at either terminal operated by attendants in telephonic communication, there also being a pilot lamp to indicate the change from direct to alternating current on the line.

But this as well as the 300 kw. monocyclic system later installed by the General Electric Company is now a thing of the past, having been replaced by the standard three phase, 60 cycle equipment since the Pacific Power & Light Company took over this and neighboring properties in 1910.

The Walla Walla River plant is now the main generating plant for this division, being a 2000 kw. hydroelectric development on the south fork of the Walla Walla River, seven miles east of Milton, Ore., and about 50 miles south of Walla Walla, these towns being connected by an interurban electric road operated by the company. This spring-fed stream rises on

Walla Walla River Hydroelectric Plant.

the west slope of the Blue Mountains and runs west to the Columbia, with a minimum flow of 100 second feet at the point of diversion. Its upper drainage area is heavily forested, the lower half being devoted to the many agricultural products which the climate and soil make possible.

A plank-faced crib dam 6 ft. high and 40 in. thick diverts the water to 5.7 miles of conduit leading to the forebay. This conduit includes 17,000 ft. of 48 in. wood-stave pipe line, 70 ft. of 7x6 ft. tunnel, and 11,000 ft. of trestle averaging 18 ft. in height, as well as 2285 ft. of open flume averaging 25 sq. ft. cross section. The forebay is a vertical wooden penstock 8 ft. square and 25 ft. deep, delivering the water under a static head of 361 ft. through 756 ft. of 42 in. pipe, the first 340 ft. being wood-stave and the last 416 ft. riveted steel of from ¼ to ½ in. thickness.

The power station is a wooden frame structure with cement plastered walls, concrete floor and wood trusses and roof. The main building is 96x31 ft., the switchboard and transformer room being 28x35 ft.

The generating equipment consists of three 800 h.p. Pelton Francis turbines and a 1000 h.p. Pelton impulse wheel, each of the former being direct connected to a 500 kw., 2300 volt Bullock generator and the latter to a 1250 k.v.a. machine. Two 24 in. Pelton impulse wheels drive the 45 kw. exciters. The governors are three Pelton type and one Lombard.

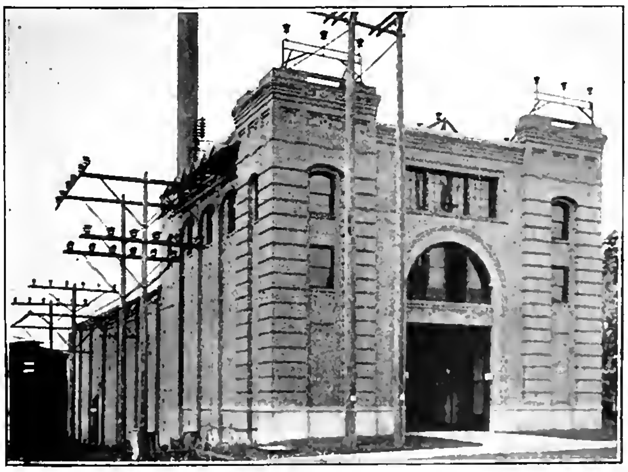
The switchboard has eight panels of 32x90 in. blue Vermont marble, there being four generator panels, two exciter panels and two switching panels.

Power is stepped up from 2300 to 25,000 volts by means of nine 250 kw., oil insulated, water-cooled transformers, feeding the 18 mile lines to Walla Walla, the 10 mile line to Freewater and the 35 mile line to Pendleton. There are also three 25 kw. transformers stepping down to 110 volts for station use. The high tension switching apparatus consists of three 45,000 volt General Electric K-6 oil switches, two controlling the high tension circuits to Walla Walla and one the two lines to Freewater and Pendleton, Ore. Lightning protection is provided by 12 Westinghouse 25,000 volt low equivalent arresters and choke coils.

A double pole line carrying No. 6 copper wire on pin type insulators transmits current at 25,000 volts to the combined substation and generating plant at Walla Walla. This is a brick building with concrete floor, steel roof trusses and corrugated iron roof, the generating station being 55x105 ft. and the substation 52x41 ft.

The Walla Walla steam plant equipment consists of a 1000 kw. Bullock generator furnishing three phase current, 60 cycles, 2300 volts, and driven at 1800 r.p.m. by an Allis-Chalmers steam turbine. Steam is supplied at 160 lb. pressure by two 500 h.p. Babcock &

Interior of Walla Walla River Plant.



Walla Walla Steam Plant.

Wilcox water tube boilers. The condenser is of the Wheeler rectangular jet type with motor driven centrifugal circulating pump and Wheeler dry vacuum pump. The boiler feed water is heated in a 3x6 ft. vertical National heater and pumped by a 10 in. x 6 in. x 10 in. duplex piston Gardner pump. Exciting current is derived from a 22.5 kw. Bullock generator driven by an American Blower Company twin 6 in. x 6 in. vertical engine.

Direct current for the **Walla Walla Valley Traction Company,** which is controlled by the Pacific Power & Light Company, is taken from a 500 kw. motor-generator set, Y2300/600 volts. This company operates 15.25 miles of interurban railway between Walla Walla and Milton, 9.71 miles in Walla Walla, and 10 miles to Freewater. The rolling stock comprises ten motor passenger cars, two trailers, one express car and two flat cars. Hourly service is regularly maintained on the interurban and fifteen minute headway on the city lines.


Interurban Car and Substation at Freewater.

Three 750 kw. transformers lower the incoming 25,000 volts to 2300 for local distribution. City arc lighting is cared for by two 7.5 ampere, 75 light, constant current transformers. Lightning protection is provided by eight 2300 volt, three phase, graded shunt, station type arresters.

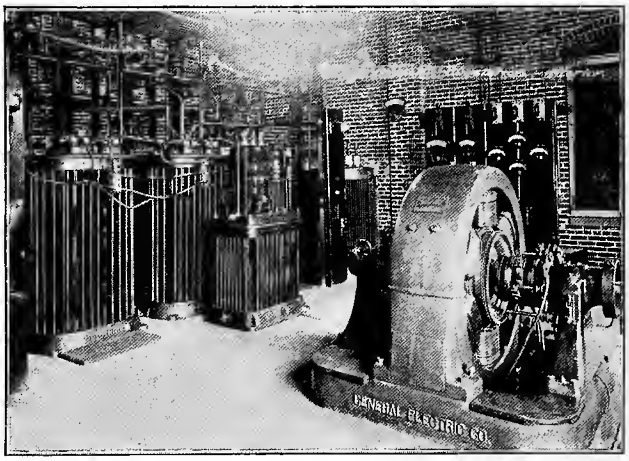
The Walla Walla-Dayton 66,000 volt line runs 31.7 miles northeasterly from the Walla Walla substation to Dayton with a branch circuit to the Waitsburg power plant. The circuit is of No. 0 copper carried by suspension insulators and closely follows the Northern Pacific railroad tracks. The power is raised from 25,000 to 66,000 volts at the Walla Walla substation by three 1000 kw. transformers and lowered to 6600 volts at the Waitsburg substation by three 500 kw. transformers. That portion of the line between Waitsburg and Dayton is operated at 6600 volts, which will be raised to 66,000 volts when the load warrants it.

The Waitsburg power plant is situated on the Touchet River 1½ miles east of the town. The equipment consists of a 150 kw., 60 cycle, three phase, 2300 volt generator belted to line shafting so that it can be driven either by water wheels or steam engine. The wheels comprise a 25 in. Victor and a 17 in. Samson-Leffell horizontal turbine. The engine is a 12 in. x 36 in. Lane & Bodley single cylinder engine.

At Dayton a 150 kw. monocyclic generator driven by a 23 in. and a 19 in. Samson-Leffell open flume type turbine is installed but not used except in case of failure of the transmission from Walla Walla.

At Pomeroy, northeast of Dayton near the Idaho line, the Pacific Power & Light Company has taken over the properties of the Tucannon Power Company, which are operated independently, though they will ultimately be tied in with the system. These include a 150 kw., 1100 volt Westinghouse generator driven by a McCormick water wheel near Marengo, power being transmitted to Pomeroy at 6600 volts, and a 100 kw. steam unit at Pomeroy.

Garfield County, of which Pomeroy is the county seat, has a population of about 5000. Wheat is the staple product, although alfalfa, fruits and garden truck are demanding much attention in the small valleys. Irrigation is confined almost exclusively to bench land along the Snake River, where water must be pumped. Some power is also necessary in conjunction with Pataha Creek pumping installations.



Interior of Freewater Substation.

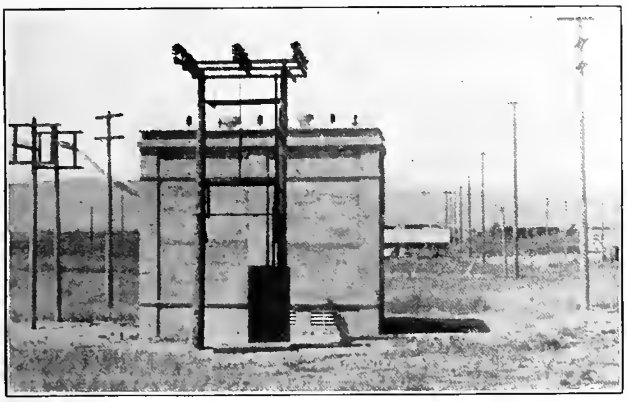
The 22,500 volt Walla Walla River-Pendleton transmission line consists of 35 miles of a double circuit of No. 6 copper wire carried on wooden poles. The line is tapped at Athena, where three 100 kw. transformers step down to 2300 volts.

The Pendleton substation is a brick building 44x45 ft., having three 250 kw. Bullock transformers, 23,500/2300 volts, air cooled, which with switchboard, lightning arresters and arc lighting equipment complete the installation. The last named includes a 34 kw. Kuhlman transformer raising to 3500, 4000 or 4500 volts, a 7.5 ampere, 4300 volt Adams Bagnall constant current regulator and arc light panel.

The Freewater 22,500 volt transmission line from the Walla Walla River plant consists of 10 miles of double circuit of No. 6 copper. The Freewater substation is a brick building 30x45 ft. and steps down the voltage for local use, including a rotary converter for the electric railway from Walla Walla, and for the line to Vincent and surrounding territory at 6600 volts. In addition to three 45,000 volt disconnecting switches there are two 45,000 volt, K.-6 General Electric oil switches. One 100 kw., three phase, delta connected, self cooled transformer lowers the voltage to 2300 volts for local use, three 75 volt units supply 370 volts

to a 200 kw. General Electric rotary converter housed in the substation and feeding direct current at 600 volts to the trolley line, and two 100 kw. transformers step down to 2200 volts for later transformation to 6600 volts through two 100 kw. units. Twenty-nine miles of 6600 volt, three phase feeder lines and eleven miles of secondary feeder lines serve irrigation needs and light and power consumers in adjacent territory.

The Attalia substation, at the townsite of Attalia where the Columbia River Canal Company irrigates 7000 acres by a gravity canal from the Walla Walla River, is fed by a tap from the Walla Walla-Pasco 66,000 volt line. Power at 6600 volts, three phase, is distributed from this substation to supply light in the town of Attalia and to serve motors in the substation of the Attalia Land Company.



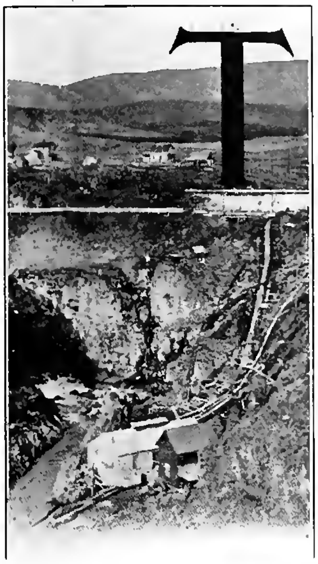
Attalia Substation.

The equipment consists of two 66,000/6600 volt General Electric transformers Y-connected on the high and delta-connected on the low, one with a capacity of 150 kw., the other 200 kw., with the usual switchboard, switching apparatus and lightning arresters.

Lower Columbia Division.

A hundred miles west of Walla Walla amid leaping waterfalls and towering cliffs the Columbia River has carved a mighty gorge through the basaltic barrier of the Cascade Mountains to give ocean outlet to the rushing waters from the east and desert inlet to the moisture laden winds from the west. Here where rail and water compete and sun and water meet are being grown some of the world's finest fruits.

Prosperous communities on either bank, The Dalles, Goldendale, Hood River and White Salmon, are the shipping centers and current consumers. The several power plants serving this territory have been acquired by the Pacific Power & Light Company, which has done much to improve the service. To the south also is a virgin empire into which the Hill and Harriman lines are being eagerly rushed up either side of the deep canyon which Deschutes River has hewn in the Columbia lavas. According to the investigations of the U. S. Geological Survey, "it has been estimated that Deschutes River, from Bend to the mouth, a distance of 140 miles, is capable of furnishing over a million horsepower." Most convenient of development and nearest to a market is its tributary, the White River, which discharges its milky flood into Deschutes about 30 miles south of its junction with the Columbia.



White River Plant.

THE White River development represents the industrial utilization of one of the most beautiful waterfalls of the West, yet without appreciably marring its natural grandeur, as may be seen in the frontispiece. With gentle slope the river flows easterly over the Columbia plateau till, near its approach to precipitous Deschutes Canyon, it plunges nearly 200 ft. in less than two miles.

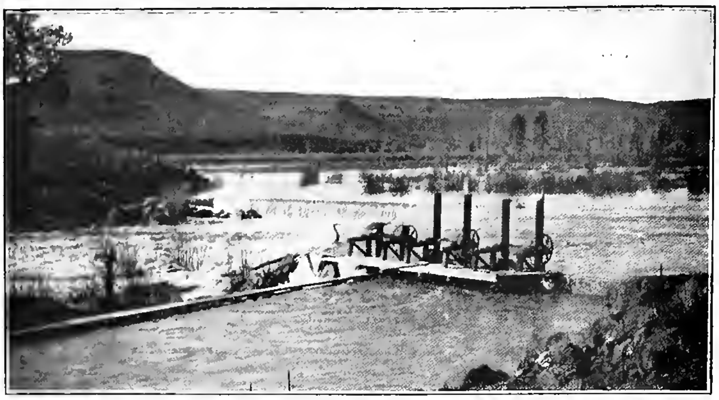
At the foot of the falls the Wasco Warehouse Milling Company installed a hydroelectric plant in 1901, transmitting the power at 20,000 volts to The Dalles. In 1910 the property was purchased by the Pacific Power & Light Company, who have since remodeled the plant, increased the head and raised the transmission voltage to 66,000, also constructing a new high tension line from The Dalles to Hood River.

A concrete dam 8 ft. high has been built across the river above the falls and diverts the water through manually operated headgates to a settling basin. From this basin a 48 in. wood-stave pipe delivers the water to a second settling basin and forebay constructed by placing a substantial concrete dam across a dry creek bed above the power house. These two settling basins are necessary on account of the large amount of sediment which the river carries from its glacial sources and which gives this stream its name. The second basin is constructed with a central division wall and gates which readily allow flushing out the accumulated silt. From the forebay a 60 in. woodstave pressure pipe 430 ft. long, with riveted steel branching terminal pipe gives 149 ft. head. Both sections of wood-stave pipe are protected from the intense rays of the sun by galvanized iron roofing.

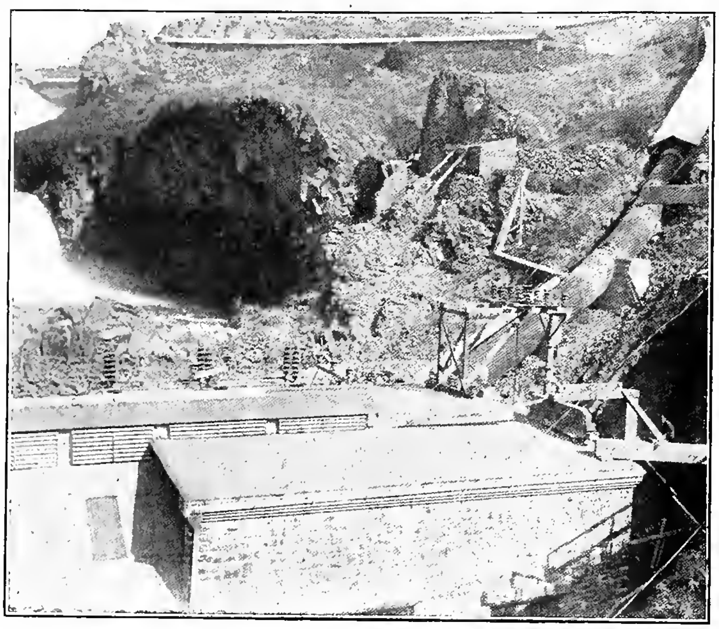
The original building was a stone masonry structure 62x33 ft. with steel trussed corrugated iron roof. By removing the north end wall a concrete extension 25x38 ft. has been built to house the transformers and lightning arresters.

The prime movers at White River comprise three Pelton Francis turbines, two having been installed in 1911 to replace impulse wheels and one being a new unit put into service in 1912. The former are 1000 h.p. wheels with Pelton governors directly connected to 500 kw., 60 cycle, three phase General Electric generators. As these wheels had to be adapted from their normal speed of 514 r.p.m. to the 225 r.p.m. of the old generators, the specific speed characteristics were quite unfavorable. Notwithstanding this handicap these wheels developed an efficiency of 82 per cent under test. Exciting current for these two machines is furnished by a 40 kw., 125 volt General Electric exciter belted to the shaft of one of them and by a similar exciter driven at 605 r.p.m. by a Pelton wheel.

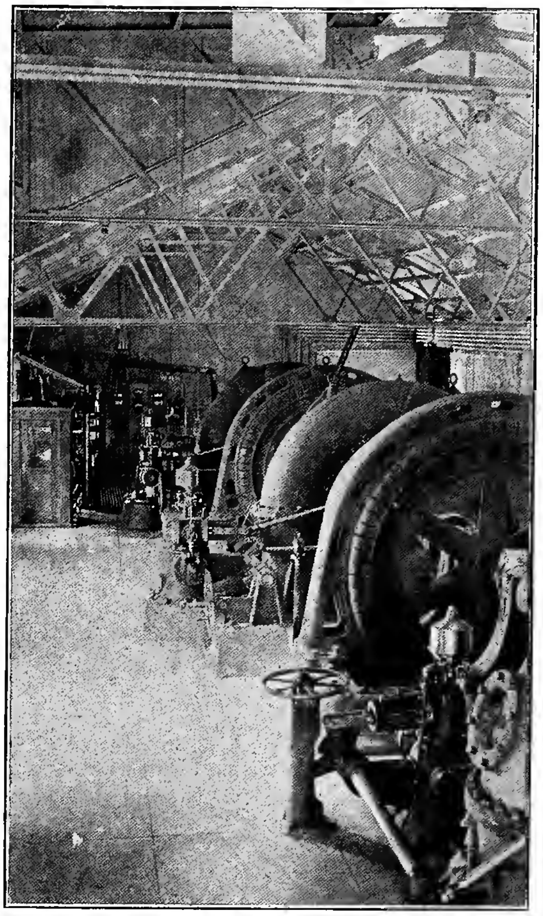
As the No. 3 unit exemplifies the latest ideas in the construction of the Pelton Francis turbine, a de-



Diversion Dam, Head Gates and First Settling Basin.



Pipe Line Penstock and Power House, With White River Falls at Left.



Interior of White River Plant.

tailed description may be of interest. The wheel is of the single discharge, three bearing type, the shaft being extended to carry the rotor of a General Electric engine type generator. As this unit provides station regulation excess fly-wheel effect was incorporated in the rotor and in addition a 10,000 lb. cast steel fly-wheel 8 ft. in diameter has been provided. This is designed to withstand a run-away speed of about 800 r.p.m., the normal speed being 514 r.p.m.

Notwithstanding the provision of double settling basins considerable glacial silt is carried by the water, so that it was necessary to case-harden and shroud all parts exposed to wear. The effective head, including draft tube, is 137.5 ft. The turbine runner is of phosphor bronze, machined and hand finished to reduce hydraulic losses to a minimum. The thrust bearing is of the cantilever type, provided with separate oil pump for constant lubrication.

The wicket gate mechanism is actuated directly by the governor, being capable of adjustment from outside the water chambers. The links controlling the guide vanes are so designed as to have a predetermined breaking strength. Water hammer in the pressure line is prevented by means of a synchronously operated Pelton automatic relief valve actuated by the governor rock shaft. Water waste is lessened by the gradual closure of the valve after relief has been afforded, the rate of closure being adjustable.

The Pelton oil pressure governor, with which this as well as the other turbines are equipped, consists of essentially four parts,—the oil pumping system, the centrifugal mechanism, the valve mechanism and the power cylinder.

The oil pressure system is placed in the base of the device, which is also arranged as an oil reservoir and air tank so that a cushion of air is constantly on the oil. The air is pumped into this tank at the end of the stroke by which the oil is forced in.

The centrifugal mechanism is situated in an enclosed drum on the governor head. Its variation in speed, as communicated by belt from the turbine shaft, controls the action of the valve mechanism whereby the oil is admitted to the power cylinder, which in turn actuates the rock shaft through lever connection.

The governor is arranged with auxiliary hand control in addition to an independent hand control directly attached to the rock shaft and separate from the governor. An over speed limiting device is also provided, so should the governor belt break and the load simultaneously drop from the turbine a tripping device will actuate the valve controlling the oil supply so as to close the turbine gate. This action is accomplished

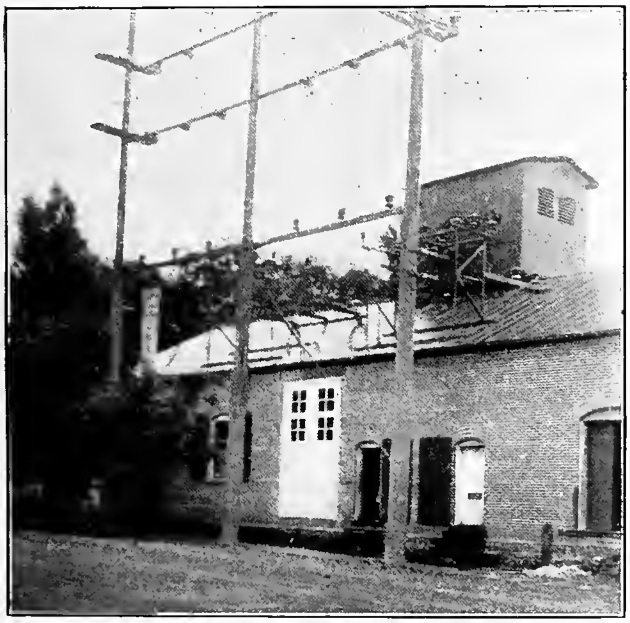
through the agency of the air pressure on the oil, there being a sufficient volume of air to care for a series of strokes.

The generator is a 1250 kw., 60 cycle, three phase General Electric machine. Exciting current is furnished by a 60 kw. exciter on the main generator shaft.

The switchboard has nine panels, three each for generators and exciters, one for instruments, one for line and one for the regulator.

Power is stepped up from 2300 to 25,000 volts for transmission to Dufur and The Dalles by means of three 1000 kw., single phase General Electric transformers, one spare being installed. A set of 66,000 volt aluminum cell electrolytic arresters give protection against lightning.

The 66,000 volt transmission to The Dalles is 27 miles long, the circuit being No. 6 copper wire on Thomas insulators. At Dufur two 50 kw. transformers step the current down to 2300 volts for local distribution.



The Dalles Substation.

At The Dalles is a 500 kw. transformer substation connected by transmission line to the generating plants at White River and Hood River. The Dalles, literally "flag-stones," was the early center of missionary activities among the Columbia River Indians and was also the site of one of the first military posts established in the Northwest. At one time a United States mint was partly built here to coin the gold from the Idaho mines. The surrounding country is the source of thousands of carloads of fruit, hay, grain and cattle. In addition to domestic lighting and power, current is supplied to the mill of the Wasco Warehouse Milling Company, who built the White River plant, and to many small irrigating plants.

The substation is a substantial brick and stone building 37x77 ft. with wood trussed sheet iron roof. It houses three 500 kw., oil-cooled, 66,000/6600 volt, single phase General Electric transformers, with the usual regulating and switching equipment. There is also a 21 kw. arc transformer for the 6.6 ampere lamps which light the town.

The seven panel switchboard is equipped to handle 550 amperes for commercial circuits, 300 amperes for the Wasco mills and 150 amperes for the Diamond mills. With the standard General Electric meter equipment for the board is included an Erstline graphic recording wattmeter.

The Dalles-Hood River transmission line is 20.6 miles long. The three power conductors are No. 0, 7 strand copper, a telephone circuit of No. 8 copper clad wire being carried on a 5 ft. cross arm below the power circuit. Though built for 66,000 volts this line is temporarily operated at 22,500.

The Hood River substation and power plant is situated about a mile from the town, the plant being used as an auxiliary to the power transmitted from White River. Power is developed at two sites, the upper consisting of a 100 h.p. McCormick water wheel driving a 75 kw., 2300 volt, 60 cycle, three phase General Electric generator and the lower a 530 h.p., 18 in., twin McCormick turbine direct connected to a 250 kw. Bullock generator supplying three phase, 60 cycle current at 2300 volts.

At each station there are two 100 kw., single phase, delta connected, 2300/6600 volt Moloney transformers and at the upper station there are also three 100 kw., 23,000/2300 volt, single phase Bullock transformers.

Hood River Valley is essentially a fruit growing community, specializing on Newtown and Spitzenberg apples, for which it is world-famed. Irrigating ditches cover the entire valley, being necessary for the cultivation of strawberries and small fruits, the rainfall being 36 inches. The valley boasts a population of about 5000, more than half the people living in or close by the town.

The White Salmon River discharges its quota into the Columbia across the river from White River. Its valley with the towns of Underwood and White Salmon is also fast becoming an apple center now that transportation facilities are available in the North Bank railroad. Excellent strawberries are raised while waiting for the orchards to come into bearing.

Power is distributed at 6600 volts throughout this promising district from a hydroelectric plant at Husum on the White Salmon River. Two 280 h.p. Samson horizontal turbines drive through belting a 75 kw., three phase, 2300 volt General Electric generator and a 5 kw. exciter. By means of three pole-type transformers current is stepped up from 2300 to 6600 volts.

Goldendale and Centerville are north of The Dalles and west of White Salmon in the rich valley of the Klickitat. These towns and the surrounding country are supplied with power by the Pacific Power & Light Company from a hydroelectric plant on the Klickitat 10 miles west of Goldendale at Blockhouse, near the site of an old blockhouse fort, the refuge of the early settlers. The generator is a 150 kw., three phase, 60 cycle Stanley machine driven at 900 r.p.m. by an 18 in. Victor Girard turbine under 300 ft. head.

The load is mostly for domestic lighting, as little irrigation pumping is necessary in this district on account of the frequent rains. Nearly all the 2000 acres under irrigation are supplied by gravity, although several private pumping projects are being developed.

Steam Turbo Generating Plant of Hammond Lumber Company Near Astoria

Astoria.

Astoria, the second city of Oregon in commercial importance and rating, was established as a fur-trading emporium in 1810 by John Jacob Astor. It occupies a most strategic position near the mouth of the Columbia River whose seven miles of width affords an excellent harbor. Most of the residence portion of the town is built on the steep hills constituting the river bank which slopes so abruptly to the water's edge as to necessitate the construction of over ten miles of planked streets built on piles in the business section, thus giving rise to its appellation of "the Venice of America." The principal industries are salmon fishing and lumbering. The former gives an annual output of about thirty million pounds, most of which is canned; the latter amounts to a yearly production of over two hundred and fifty million feet.

The refuse from one of these mills, that of the Hammond Lumber Company, is the fuel for twelve tubular boilers furnishing steam to the two 800 kw., horizontal Curtis turbo-generators which now furnish most of the electric current used at Astoria. The Pacific Power & Light Company finds it more economical to buy this power than to regularly operate the reserve steam plant which they bought from the Astoria Electric Company.

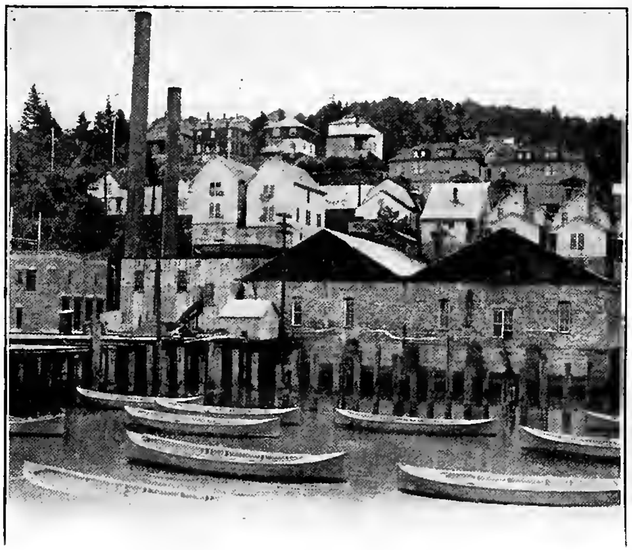
Power is transmitted at 22,500 volts from the mill at Tongue Point, four miles from Astoria, by means of a double line of 50 ft. and 75 ft. poles carrying No. 6 copper wire on pin insulators.

The substation is a substantial reinforced concrete building 21x31 ft. adjoining the power plant and housing four (one spare) 300 kw., delta connected, 22,500/2300 volt transformers. There are also three 50 light, constant current tub transformers with mercury arc rectifier sets for arc lighting. Aluminum cell lightning arresters are installed.

The power apparatus is housed in a brick and corrugated iron engine room 150x98 ft. and a boiler room 57x58 ft. The main generator is a 500 kw., three phase, 60 cycle, 2300 volt General Electric machine direct connected to a 1000 h. p., vertical cross-compound, non-condensing McIntosh & Seymour engine. Exciting current is obtained from an engine-driven 27 kw. exciter and steam is supplied by one 750 h.p. and two 200 h.p. Cahall, Aultman & Taylor water tube boilers equipped with wood-burning Dutch oven and fire bases respectively. Feed water is heated by a 7x3 ft. Goubert closed primary heater and pumped by a 7½x4½x6 in. duplex piston Blake pump. Another 300 kw., single phase generator and 550 h.p. engine is not in use.

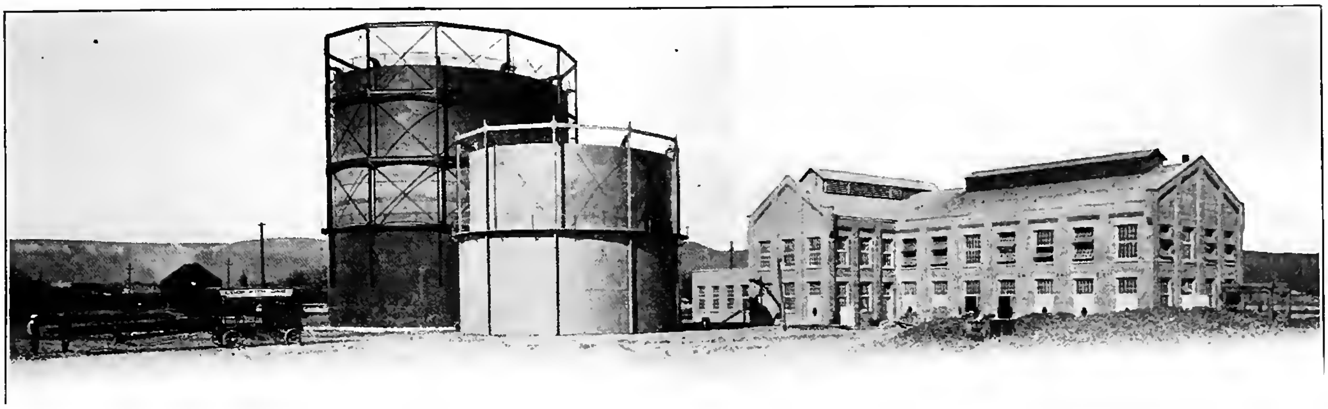
Direct current for the Astoria electric railway which this company also operates is furnished by a 225 kw., motor-generator set also arranged for belt drive from a 400 h.p. Watts-Campbell engine. The motor is a 350 h.p., 2300 volt, three phase General Electric induction machine, driving a 225 kw., 500 volt, direct current General Electric generator.

The switchboard has nine panels of blue Vermont marble equipped with General Electric instruments. These include one incoming line panel, an induction motor panel and two railway generator panels, two a.c. generator panels with exciter panel, a three phase feeder and three single phase feeder panels.



Astoria Substation and Steam Plant.

This was the first property in the Pacific Northwest to be acquired by the American Power and Light Company and differs from all others in that there is no possibility of developing a pumping load for irrigation, as the average annual rainfall is over 75 inches. The city is prosperous and progressive, rapidly adopting the many modern current consuming devices for the home which fill in the valleys of the load curve.



Gas Plant at North Yakima.

Gas Plants.

The Pacific Power & Light Company operates gas plants at North Yakima and Walla Walla, Wash., Lewiston, Idaho, Pendleton and Astoria, Oregon, gas being made from coal excepting at Astoria.

The North Yakima gas works is the newest, having been completed early in 1912. The apparatus is housed in a brick building 101x45 ft. with two wings. Especial attention was paid to ample window illumination. The capacity of the three benches now installed is 300,000 cu. ft. daily, provision having been made for another bench.

The retorts, or gas generators, are 18 in number, there being three benches of six each. The retorts are double ended, 26x15 in. inside and 11 ft. long, being of Laclede-Christy make. Coal is fired at one end from cars on an industrial railway and coke is pushed out at the other by a specially designed hand pusher. The hot coke falls into hopper pits, where it is water cooled and stored till withdrawn by the coke car. Most of it is burned for fuel under the retorts. Steam is supplied by a 75 h.p. Frost horizontal return tubular boiler.

A 6 in. cast iron stand pipe connects the mouth of each retort to the hydraulic main whence the gas is exhausted to the condensers and the liquor drawn into the tar well and purifier.

The tar well and purifier is 16x24 ft. inside cross-section and 10½ ft. deep, having 12 in. concrete walls and reinforced concrete covering. It is divided into two sections, the ammonia well occupying one-third its length and the tar well two-thirds. The liquor is discharged through a 3 in. drip pipe into a chamber 4x3 ft. and 5 ft. deep. From this chamber a 3 in. pipe at the surface discharges into the ammonia well and a 6 in. pipe near the bottom leads to the tar well.

The gas passes from the hydraulic main through a 12 in. cast iron pipe leading to the primary condenser, a vertical steel shell 6 ft. in diameter and 20 ft. high equipped for air and water cooling. Thence the 12 in. pipe branches to two 10 in. sections, each leading to a No. 4 Roots exhauster, one driven by a Troy engine, the other by an electric motor. After leaving the exhausters a 12 in. gas main carries the gas to the final condenser. It then passes through a water spray and two scrubbers, which remove the ammonia, into the purifiers and finally to the meter, which is equipped with pressure valve.

The gas is stored in two steel holders, one a single lift of 43,000 cu. ft. capacity, the other a double lift of 151,000 cu. ft. capacity. The gas is drawn from the holders by two compressors, which discharge into two large storage tanks which feed the city mains. Most of the apparatus was installed by the Gas Machinery Company of Cleveland, Ohio.

Gas Plant at Lewiston, Idaho.

The Walla Walla gas plant is being reconstructed. The building is of brick on concrete foundations with concrete floors and asbestos covered roof. There are two benches of retorts, one being a Doherty bench of sixes, the other a Mitchell regenerative bench of sixes. The primary condenser is 4 ft. in diameter and 19 ft. high, one of the secondaries has the same height and a diameter of 6 ft., the other is 3½ ft. x 12 ft. A single Kerr-Murray exhauster with 10 in. connections is driven by a vertical steam engine. The two scrubbers have the same dimensions as the secondary condensers, the purifiers are 9 ft. x 11 ft. The meter is a 66 in. Maryland type equipped with Heinmon drums and having a 24 hour measuring capacity of 432,000 cu. ft. with 1 in. loss in pressure.

There are two steel holders, one two-lift with a capacity of 100,000 cu. ft. and one single-lift with a capacity of 40,000 cu. ft. These with a tar well extractor and 60 h.p. boiler complete the station equipment.

The Lewiston gas plant also serves the town of Clarkston, Wash., the gas main being extended across the river on the bridge connecting the two towns. Gas is generated by means of one bench of six Mitchell semi-regenerative retorts and two benches of five direct firing retorts. There is but one condenser, 6 ft. in diameter and 20 ft. high, containing 60 2 in. tubes. A No. 2 Roots exhauster is direct connected to a 3x5 in. vertical engine. The scrubber is 18 ft. high and 4 ft. 8 in. in diameter, the two purifier boxes are 10x12x3 ft. and the boiler a 20 h.p. horizontal return tubular. A 6 in. American station meter measures the gas before it is stored in the 31,000 cu. ft., single-lift steel holder. An 8 in. x 10 in. x 6 in. Hall compressor forces the gas through the mains.

The Pendleton gas plant is the smallest of those operated by the company and adjoins the Pendleton electric substation. The equipment includes one bench of 3 semi-regenerative and one bench of 4 half-depth Mitchell semi-regenerative retorts. The condenser, scrubber and two purifiers are of Kerr-Murray make, the former having 6 in. connections. The exhauster is an engine-driven No. 2 Root blower. The tar well consists of two tanks 12 ft. deep, one being of concrete 10x10 ft., the other of ¼ in. steel 3 ft. in diameter. The P. & A. tar extractor with 6 in. connectors is similar to those installed in the Walla Walla and Lewiston plants. The holder has a capacity of 20,000 cu. ft., single-lift cupped for double-lift.

The Astoria gas plant has a crude oil gas generator and superheater 4 ft. 6 in. in diameter and 20 ft. high. The condenser is of 2 ft. diameter and 12 ft. height; the three scrubbers, 20, 18 and 10½ ft. high and 5½, 5 and 3 ft. in diameter respectively, all being made by Dole & Co., who also constructed one of the purifiers which is 10 ft. in diameter and 6 ft. deep. Of the three other purifiers, one is of the enclosed type, 12 ft. in diameter and 6 ft. high and two are water sealed, 6 ft. boxes. The exhauster is a No. 2 Root rotary driven by a 5 h.p. vertical engine. The tar extractor is a 4 ft. box made by the Cleveland Gas Machine Company. Steam is furnished by a 50-75 h.p. marine type boiler and the gas is measured by a 42 in. McDonald station meter with 6 in. connections. The main holder is a brick and concrete tank 50 ft. across and 18 ft. high with a capacity of 35,000 cu. ft., there also being a 5000 cu. ft. single-lift steel relief tank.

Conclusion.

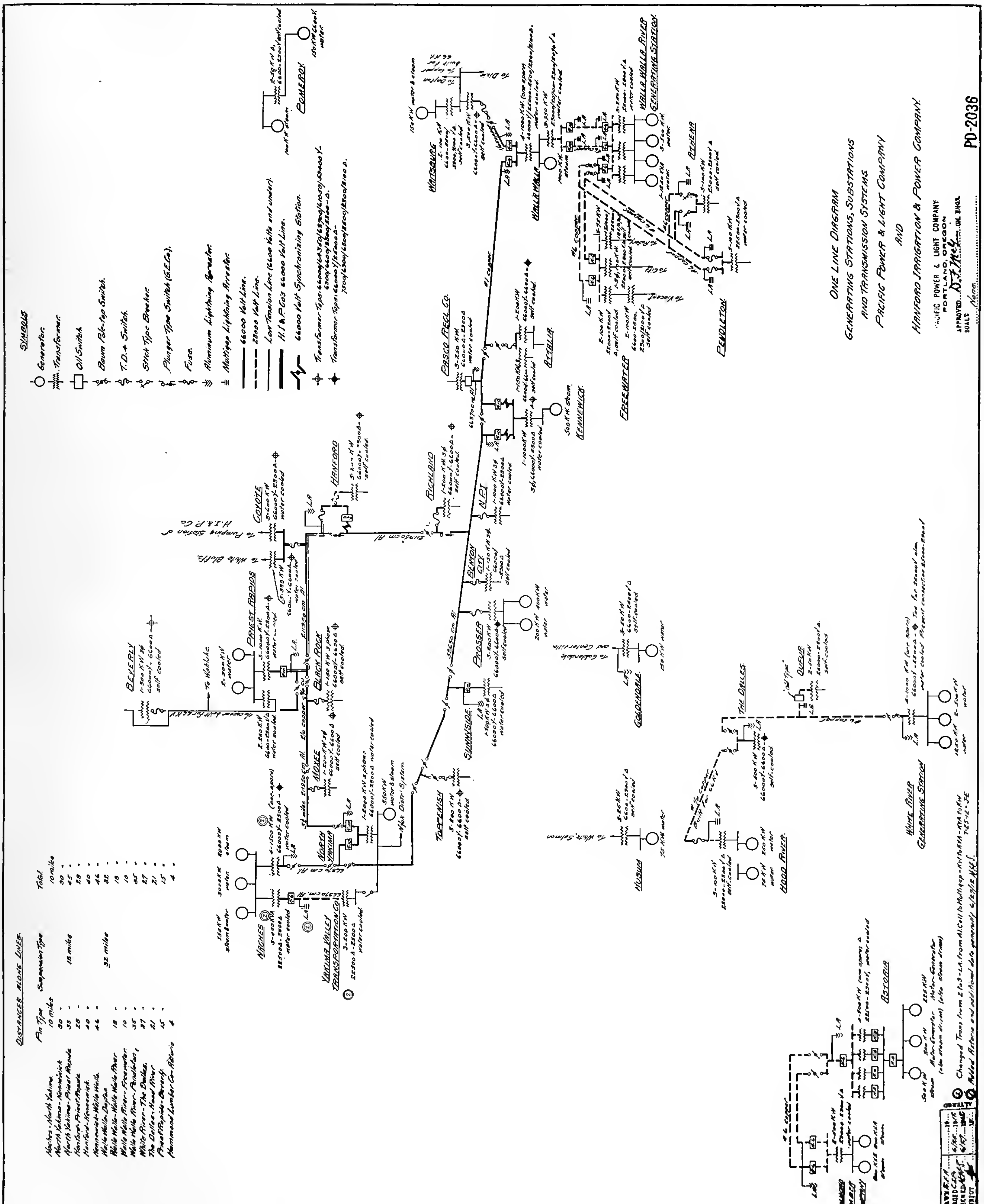
The foregoing survey of the Pacific Power & Light Company's properties show it to be one of the world's most extensive high-tension transmission sys-

Cabbages and Apples on Irrigated Land.

tems caring for a load dependent upon irrigation. The company already has about 3500 h.p. of motor-driven pumps and is fast increasing this most desirable load. In addition the following towns are given the service shown in the tabulation:

City.	Population.	Service Supplied.
North Yakima, Wash.	16,000	L. & P., Gas, Water Works
Wapato, Wash.	800	L. & P.,
Toppenish, Wash	2,000	L. & P.,
Zillah, Wash.	300	L. & P.,
Granger, Wash.	350	L. & P.,
Outlook, Wash.	100	L. & P.,
Sunnyside, Wash.	1,800	L. & P.,
Mabton, Wash.	700	L. & P.,
White Salmon, Wash.	1,000	L. & P.,
Husum, Wash.	100	L. & P.,
Goldendale, Wash.	1,500	L. & P.,
Centerville, Wash.	200	L. & P.,
Grandview, Wash.	400	L. & P.,
Benton City, Wash.	100	L. & P.,
Prosser, Wash.	2,000	L. & P., Water Works.
Richland, Wash.	150	L. & P.,
White Bluffs, Wash.	200	L. & P.,
Beverly, Wash.	100	L. & P.,
Kennewick, Wash.	1,600	L. & P., Water Works.
Pasco, Wash.	2,500	L. & P., Water Works.
*Attalia, Wash.	200	L. & P.,
Walla Walla, Wash.	22,500	L. & P., Gas, Electric Ry.
Waitsburg, Wash.	1,500	L. & P.,
Huntsville, Wash.	200	L. & P.,
Dayton, Wash.	2,500	L. & P.,
Marengo, Wash.	100	L. & P.,
Pomeroy, Wash.	1,750	L. & P.,
Clarkston, Wash.	1,500	Gas
Lewiston, Idaho	7,000	Gas
Freewater, Oregon	600	L. & P., Electric Railway..
Milton, Oregon	1,500	Electric Railway..
*Weston, Oregon	600	L. & P.,
*Athena, Oregon	900	L. & P.,
Pendleton, Oregon	5,000	L. & P., Gas
The Dalles, Oregon	5,500	L. & P.,
Dufur, Oregon	650	L. & P..
Hood River, Oregon	3,000	L. & P.,
Astoria, Oregon	10,000	L. & P., Gas, Electric Ry.
Rural Communities	5,000	L. & P.,
Total	101,900	

*Wholesale only.


ONE LINE DIAGRAM
GENERATING STATIONS, SUBSTATIONS
AND TRANSMISSION SYSTEMS
PACIFIC POWER & LIGHT COMPANY
AND
HANFORD IRRIGATION & POWER COMPANY.
PACIFIC POWER & LIGHT COMPANY
PORTLAND, OREGON
PD-2036
SYMBOLS
DISTANCES ALONG LINES
WALLA WALLA RIVER GENERATING STATION
WHITE RIVER GENERATING STATION
POMEROY
PENDLETON
ATHENA
WAITSBURG
WALLA WALLA
FREEWATER
KENNEWICK
PASCO RECL. CO.
RICHLAND
HANFORD
COYOTE
PRIEST RAPIDS
BEVERLY
BLACK ROCK
N.P.I.
BENTON CITY
PROSSER
SUNNYSIDE
TOPPENISH
MOXEE
NORTH YAKIMA
NACHES
YAKIMA VALLEY TRANSPORTATION CO.
GOLDENDALE
HUSUM
THE DALLES
DUFUR
HOOD RIVER
ASTORIA

Irrigation Company's Charges.

	Number of acres Irrigated.	Annual Maintenance.	Water Cost per acre.	Water duty.	In g. p. m. per acre.	6½% on investment per acre.	Total annual cost for 1 g. p. m. per acre.	Remarks.
Sunnyside	70,000	$0.95	$52.00	3 acre ft.	4.25	$3.38	$1.02	Government Gravity
Umatilla	25,000	1.30	60.00	2.8 acre ft.	3.97	3.90	1.31	Government Gravity
Tieton	35,000	1.50	93.00	2.17 acre ft.	3.08	6.05	2.44	Government Gravity
Congdon	4,200	2.00	100.00	1 sec. ft. per 106	4.50	6.50	1.89	Private Gravity
Selah-Moxie ..	6,000	2,00	35,00	1 sec. ft. per 160	2.81	2.27	1.52	Private Gravity
Hanford	16,000	2.50	100.00	2 acre ft.	2.83	6.50	3.17	36 ft. lift
Kennewick ...	11,000	1.50	100.00	2 acre ft.	2.83	6.50	2.82	100 ft. lift
Prosser Falls..	1,600	1.50	75,00	1 sec. ft. per 160	2.81	4.88	2.27	50 ft. lift

Cost of Electric Pumping.

Irrigating 160 acres, allowing 450 g. p. m. by direct-connected 4-inch pump.

Head.	Horse Power.	Initial Cost.	Interest and Depreciation.	Power Charges.	Total Yearly Charge.	Total Annual Cost for 1 g. p. m. per acre.
20 ft. ..	5	$800	$92	$210	$302	$1.075
30 ft. ..	7	880	101	294	395	1.40
50 ft. ..	11	1010	115	462	577	2.06
75 ft. ..	16½	1100	127	693	820	2.91
100 ft. ..	22	1250	144	924	1068	3.69

The query that most naturally comes to the mind of the reader is whether the demand for power will keep pace with the growth of the country. Can electric pumping compete with the great gravity canals which Federal and private enterprise are building? To both of these questions the facts demonstrated by experience bear out a most emphatic affirmative answer.

The gravity ditch is a co-operator rather than a competitor of electricity, for it is the means of bringing a greater population to require the public utilities which this company provides. Furthermore, it frequently happens that a consumer uses power to pump water from the ditch to a higher level than the gravity canal reaches. There is also much land not reached by the gravity canals which can be irrigated by well pumping, certain sections having great areas of easily tapped ground waters.

The cost of electric pumping as compared with the charges of several of the irrigation companies is shown in the accompanying tables which have been adapted from those of H. S. Wells, contract agent for the Pacific Power and Light Company. The costs become prohibitive for orchards above 100 ft. lift, alfalfa and hay not allowing much above 30 ft. lift on account of their smaller return per acre.

The pumping installations average from 5 to 15 h.p., varying from 1 to 120 h.p. Contracts are taken for a minimum of five years and are protected by a lien on the customers' property which will cover the amount of the bills during the terms of the contract. The company will make line extensions and install meters and transformers if the first year's gross earnings are at least 35 per cent the cost of the extension.

The thorough organization and the aggressive manner by which this company seeks new business is characteristic of each of the other departments. General offices are maintained at Portland and local offices at each of the important field points.

The Pacific Power and Light Company was incorporated in 1910 as a subsidiary of the American Power and Light Company of New York City, one of the interests of the Electric Bond and Share Company.

LOSSES IN COAL PRODUCTION.

During the last year, in producing half a billion tons of coal we wasted or left underground, in such condition that it probably will not be recovered in the future, a quarter of a billion tons of coal; we turned loose into the atmosphere a quantity of natural gas larger than the total output of artificial gas during the same period in all the towns and cities of the United States; we also wasted or lost in the mining, preparation and treatment of other important metalliferous and non-metalliferous minerals from 10 to 50 per cent. of the year's production of such minerals.

The above is the startling manner in which Dr. Joseph A. Holmes, Director of the United States Bureau of Mines describes some of the losses in the yearly production of two billion dollars worth of minerals in the United States

In referring to the waste in the mining and use of coal, Mr. Parsons states that the wastes of carbon in our modern economy are almost incomprehensible. In mining coal in this country, probably one-third of the bituminous coal and one-half of the anthracite are left in the mine. Fully 80,000,000 tons of anthracite is now being left behind in the mine each year, and it is estimated that since mining began in this country fully two billion tons of anthracite and three billion tons of bituminous coal have been left in the ground under conditions which make future recovery highly impossible.

After coal is mined, the losses by no means cease, although some of the culm that formerly went to waste by millions of tons is now being used. Probably not over eleven per cent of the energy in coal is being effectively utilized. The remainder of the energy's lost through the inefficiency of the steam boiler. the steam engine and the electric dynamo.

It is estimated that the boiler scale in locomotives alone in this country means a loss of over 15,000,000 tons of coal annually. It has been shown that one-sixteenth of an inch of scale means a loss of 25 per cent in boiler efficiency. The scientific control of the combustion of coal under boilers is constantly increasing, but the losses of carbon that is still pouring from our chimneys, defacing monuments, buildings and landscapes are without valid reason.

The losses in making of coke by the old-fashioned process wasted $40,000,000 in the United States last year. He calls this an entirely needless and seemingly ruthless loss. He declares that these coke ovens, without taking into account the value of the by-products that were possible, wasted more than one million horsepower in the year. All this loss might be prevented by the use of modern methods, he says.

LIGHT AND POWER RATES OF SEATTLE MUNICIPAL PLANT.

BY J. D. ROSS.

The city plant first began in 1904 with a residence rate of 8½c per kw.-hr. for the first 20 kw.-hr. shown on the meter, 7½c for the next 20 kw.-hr., 6½c for the next 20 kw.-hr., and 4½c per kw.-hr for all over 60 kw.-hr.

The rate charged by the competing company when the preliminary work of the plant began was based on the connected load of the residence. The first two hours of connected load was given at a rate of 20c per kw.-hr. This rate was reduced later to 12½c, still based on the connected load. Then, in 1907, the competing company adopted the system of residence rates used by the city plant, giving a rate of 10c, 9c, 8c and 5c, with a 10 per cent discount for cash. In 1911 this was further reduced, to 9½c, 8½c, 7½c and 5c, with 10 per cent discount for cash.

In 1911 the city residence rate was reduced to 7c for the first 60 kw.-hr., and 4c per kw.-hr. for all over 60 kw.-hr., as shown on the meter. with a minimum of $1.00 per month. After 24 months' service the rate is 6c and 4c, with a 75c minimum.

For street lighting the plant is allowed the following rates from the general fund:

6.6 ampere arcs and 400 watt 6.6 ampere tungsten lamps, per year	$54.00
50 watt, 6.6 ampere tungsten lamps	13.80
5 globe cluster lights, 200 watts	42.00
3 globe cluster lights, 120 watts	30.00
1 globe cluster lights, 75 watts	21.00

The general schedule of business and power rates is as follows:

A. For all constant potential arc and incandescent loads, used for residence lighting purposes:

For the first twenty-four (24) months after installation of meter:

0 to 60 kilowatt hours, per month, 7 cents per kilowatt hour.

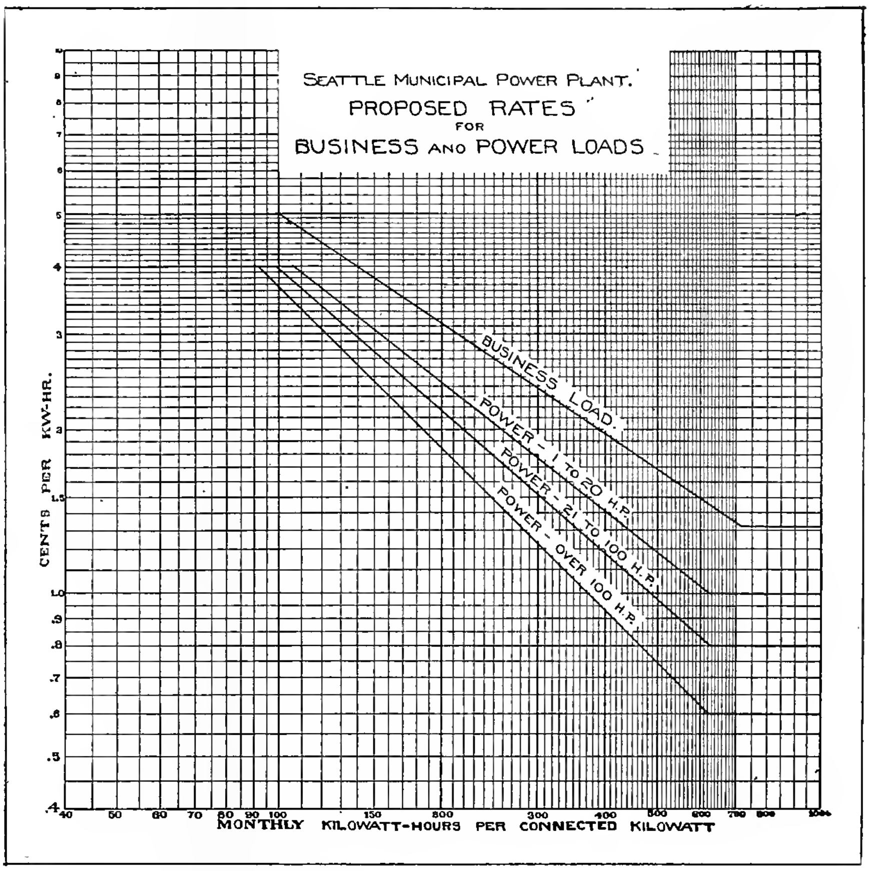
All over 60 kilowatt hours, per month, 4 cents per kilowatt hour.

After the first twenty-four (24) months from installation of meter (effective from and after July 1, 1912):

0 to 60 kilowatt hours, per month, 6 cents per kilowatt hour.

All over 60 kilowatt hours, per month, 4 cents per kilowatt hour.

The above rates include the use of clear carbon or metallized filament lamps. The same schedule of charges shall be made for churches as for residence lighting. The minimum charge per account for each meter installed for residence lighting shall be one (1) dollar per month for the first twenty-four (24) months after installation of meter and seventy-five (75) cents per month thereafter; said minimum charge of seventy-five (75) cents per month shall apply to all accounts which at time of taking effect of this ordinance shall have been in force for twenty-four (24) months continuously. In cases of apartment houses, each apartment shall be rated as a separate residence.



B. For all constant potential arc and incandescent loads, used for business lighting purposes:

For lighting business houses on the basis of a connected load of 16 candlepower 50 watt lamps:

0 to 60 kilowatt hours per month inclusive, per connected kilowatt, 8 cents.

72.5 kilowatt hours per month, per connected kilowatt, 7 cents.

90 kilowatt hours per month, per connected kilowatt, 6 cents.

116 kilowatt hours per month, per connected kilowatt, 5 cents.

160 kilowatt hours per month, per connected kilowatt, 4 cents.

240 kilowatt hours per month, per connected kilowatt, 3 cents.

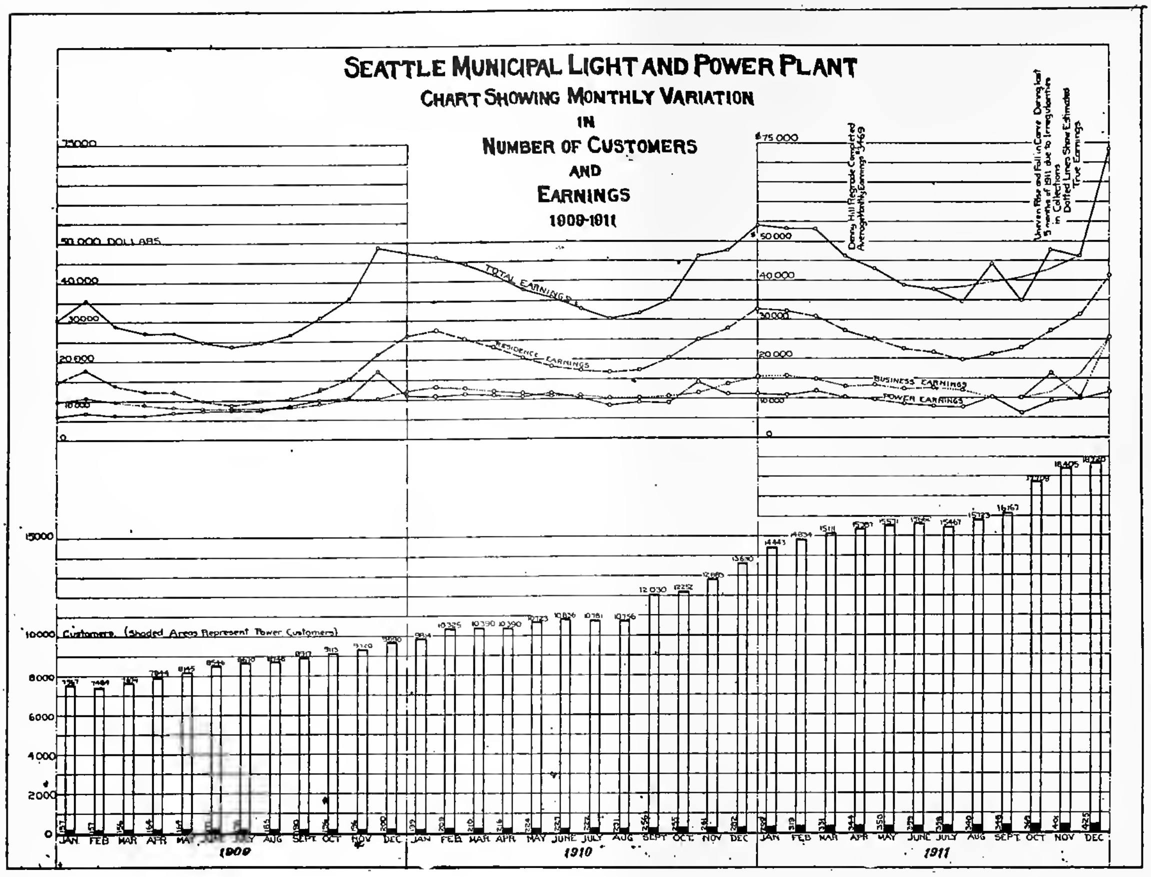
312 kilowatt hours per month, per connected kilowatt, 2½ cents.

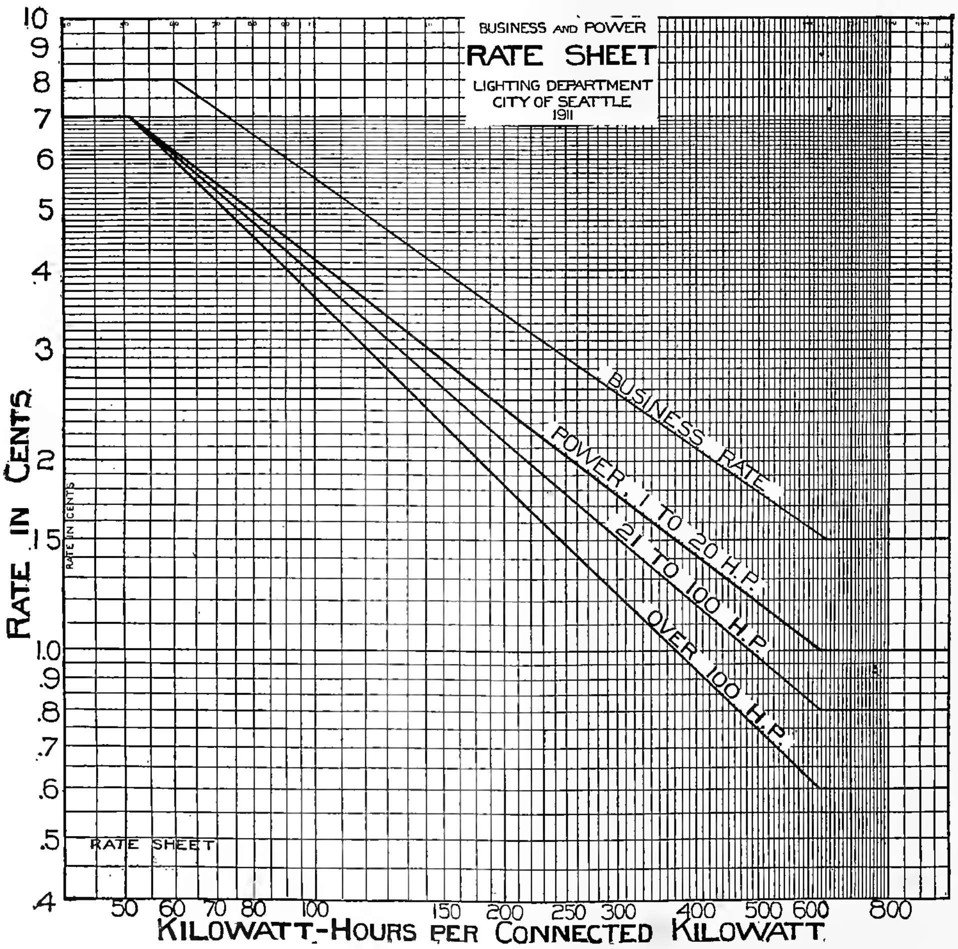
425 kilowatt hours per month, per connected kilowatt, 2 cents.

640 and over kilowatt hours per month, per connected kilowatt, 1½ cents.

Intermediate kilowatt hours consumption shall be charged at intermediate rates. A minimum rate shall be charged for all business lighting. Such minimum to be fixed by the Superintendent, but in no case to be less than one (1) dollar per month.

C. Rates for power purposes based on a con-


SEATTLE MUNICIPAL LIGHT AND POWER PLANT
CHART SHOWING MONTHLY VARIATION IN NUMBER OF CUSTOMERS AND EARNINGS
1909-1911
TOTAL EARNINGS
RESIDENCE EARNINGS
BUSINESS EARNINGS
POWER EARNINGS
Customers. (Shaded Areas Represent Power Customers)
1909
1910
1911


BUSINESS AND POWER
RATE SHEET
LIGHTING DEPARTMENT
CITY OF SEATTLE
1911
BUSINESS RATE
POWER, 1 TO 20 H.P.
21 TO 100 H.P.
OVER 100 H.P.
RATE IN CENTS
KILOWATT-HOURS PER CONNECTED KILOWATT
RATE SHEET

nected load of less than one horse power shall be reckoned on same basis as business lighting rates.

Rates for power purposes based on a connected load of 1 to 20 horsepower inclusive, of 746 watts per horsepower per month of 26 days, shall be as follows:

0 to 52 kilowatt hours per month, inclusive, per connected kilowatt, 7 cents.

63.5 kilowatt hours per month, per connected kilowatt, 6 cents.

80.04 kilowatt hours per month, per connected kilowatt, 5 cents.

106 kilowatt hours per month, per connected kilowatt, 4 cents.

154 kilowatt hours per month, per connected kilowatt, 3 cents.

257 kilowatt hours per month, per connected kilowatt, 2 cents.

375 kilowatt hours per month, per connected kilowatt, 1½ cents.

624 and over kilowatt hours per month, per connected kilowatt, 1 cent.

Intermediate kilowatt hours consumption shall be charged at intermediate rates.

Rates for power purposes based on a connected load of 21 to 100 horsepower inclusive, of 746 watts per horsepower per month of 26 days shall be as follows:

0 to 52 kilowatt hours per month, inclusive, per connected kilowatt, 7 cents.

62 kilowatt hours per month, per connected kilowatt, 6 cents.

76.4 kilowatt hours per month, per connected kilowatt, 5 cents.

99 kilowatt hours per month, per connected kilowatt, 4 cents.

137.5 kilowatt hours per month, per connected kilowatt, 3 cents.

218 kilowatt hours per month, per connected kilowatt, 2 cents.

305 kilowatt hours per month, per connected kilowatt, 1½ cents.

483 kilowatt hours per month, per connected kilowatt, 1 cent.

545 kilowatt hours per month, per connected kilowatt, 0.9 cent.

624 kilowatt hours per month, per connected kilowatt, 0.8 cent.

Intermediate kilowatt hours consumption shall be charged at intermediate rates.

Rates for power purposes based on a connected load of 101 horsepower and over, of 746 watts per horsepower, per month of 26 days, shall be as follows:

0 to 52 kilowatt hours per month, inclusive, per connected kilowatt, 7 cents.

60.75 kilowatt hours per month, per connected kilowatt, 6 cents.

73 kilowatt hours per month, per connected kilowatt, 5 cents.

91.4 kilowatt hours per month, per connected kilowatt, 4 cents.

122 kilowatt hours per month, per connected kilowatt, 3 cents.

184 kilowatt hours per month, per connected kilowatt, 2 cents.

246.6 kilowatt hours per month, per connected kilowatt, 1.5 cents.

371.8 kilowatt hours per month, per connected kilowatt, 1 cent.

414 kilowatt hours per month, per connected kilowatt, 0.9 cent.

466 kilowatt hours per month, per connected kilowatt, 0.8 cent.

534 kilowatt hours per month, per connected kilowatt, 0.7 cent.

624 kilowatt hours per month, per connected kilowatt, 0.6 cent.

Intermediate kilowatt hours consumption shall be charged at intermediate rates.

A minimum charge of one (1) dollar per month shall be made for each connected horsepower.

THE STATE HIGHWAY OF CALIFORNIA.

Much interest attaches to the progress of the California State highway. At the recent meeting of the Pacific Highway Association in San Francisco, Austin B. Fletcher, highway engineer for the California Highway Commission, delivered a paper on the progress of the work thus far undertaken. In brief the work was described by Mr. Fletcher as follows:

The California Highway Commission has been engaged in its duties very nearly one year. On August 7, 1911, the appointed members of the Advisory Board of the Department of Engineering, Messrs. Towne, Blaney and Darlington were commissioned by the Governor and as soon thereafter as possible the Advisory Board appointed them as an executive committee of the department to be known as the California Highway Commission, giving to them as complete control over state highways matters as the law permits.

California, unlike the Eastern States, did not provide for a commission to investigate the needs of the state in the matter of highways before appropriating money for their construction. The California State Highways Act, which is the law and the gospel under which the state highway routes must be selected and in accordance with which the roads must be built, in a general way, outlines the routes.

In the language of the Act: "The route or routes of said state highways shall be selected by the department of engineering and said route shall be so selected and said highways so laid out and constructed or acquired as to constitute a continuous and connected state highway system running north and south through the state, traversing the Sacramento and San Joaquin valleys and along the Pacific Coast by the most direct and practicable routes, connecting the county seats of the several counties through which it passes and joining the centers of population, together with such branch roads as may be necessary to connect therewith the several county seats lying east and west of such state highway."

The precise meaning of the section of the Act just quoted has given the public, the commission, and its legal advisers food for much thought.

There is no doubt that a line down the coast and a line down the Sacramento and San Joaquin valleys were contemplated, but how to connect the county

seats and the centers of population by the "most direct and practicable routes," and to connect the county seats east and west of the state highways by branches so as to satisfy the law and the people is a problem difficult of solution.

Fortunately, except in perhaps a half dozen instances, it seems probable that there will be no serious disagreement as to the proper location for the routes.

It is natural that each community should wish to have the main line of the highway pass through its borders, and it is obvious that such a line would be so meandering as to be impossible because of its indirectness and consequently greatly increased length.

The commissioners have been obliged to take a broad view of the subject. The state highway system must be planned from a state-wide viewpoint and no undue emphasis should be given to the desires of the communities themselves. In the absence of rulings by the courts it would seem that the command of the statute that the state highway shall follow the "most direct and practicable routes," clothes the commissioners and the advisory board with a good deal of discretion in locating the lines of the highways.

Acting upon that belief the commission has in a few instances proposed to locate the main route of the highway in such a manner that one or more county seats would not be on it and could reach it only by a lateral. In several cases such action has aroused a storm of protest. All sorts of reasons have been credited to the Highway Commission and to the administration, it having been even alleged that the state highways are being routed for political purposes and to buy votes. It hardly seems to be worth while to deny such allegations. The writer disclaims any close acquaintance with so-called practical politics, but he has been engaged in public work for so many years that he believes himself able to smell the animal when it is prowling about. Not only has he seen no evidence of politics in highway routing, but on the contrary the accredited friends of the administration have abused the highway commissioners for their proposed routings more than have its enemies.

The highway work, in all its roots and branches, has been and is singularly free from the sinister machinations of practical politicians.

Early in its work the commission chose certain main routes as follows:

Route 1.	San Francisco to Oregon line	421 miles
Route 2.	San Francisco to San Diego via Los Angeles.	592 miles
Route 3.	Sacramento to Oregon line via east side of river and Redding	344 miles
Route 4.	Sacramento to Los Angeles via San Joaquin Valley	445 miles
Route 5.	Stockton to Santa Cruz via Oakland	133 miles
Route 6.	Sacramento to Woodland Junction	20 miles
Route 7.	Tehama to Benicia	191 miles
Route 8.	Hopland to Vallejo via Lake County	107 miles
Route 9.	Los Angeles to Riverside	46 miles

In brief the standard road which the commission proposes to build, will have the following principal characteristics:

1. A right of way not less than 60 ft. in width where it is reasonably possible and as direct between objective points as is consistently possible.

2. Gradients not exceeding 7 per cent even in the mountainous parts of the state.

3. Curves as open as possible and in no case of less than 50 ft. in radius.

4. As many culverts of sufficient capacity as are needed to take care of surface and underground water.

5. A travelled way under ordinary conditions not less than 21 ft. in width and in the mountains not less than 16 ft. wide, with the center paved or surfaced so as to be hard and smooth under all climatic conditions at all times of the year, the width of surfacing to be in general 15 ft.

6. Smoothly graded road sides, reserved for future tree planting.

For the main roads of the system the choice for surfacing seems to lie between the so-called oil macadam type and a concrete road with a bituminous surface, the latter being considerably more expensive than the former, but much more desirable as concerns quality and permanency. It is evident that neither type can be adopted for general use unless the cost of the materials and the freight charges for transporting them are reduced to the lowest point possible.

It seems apparent that not less than 2700 miles of state highway must be built to comply with the provisions of the "State Highways Act." Of this mileage it is possible that one-third, or 900 miles, will be in the mountains, and will require no surfacing other than local gravels, and that 1800 miles will have to be surfaced with materials more or less expensive.

A crude estimate shows that the Southern Pacific Company will be concerned in hauling materials for not less than 1000 miles of the state highway. Otherwise expressed, should the 1000 miles referred to be built of oil macadam, the railroad will have to transport not less than 2,900,000 tons of broken stone and 260,000 barrels of asphaltic oil during the progress of the work, to say nothing of huge quantities of cement, culvert pipe, lumber, reinforcing steel, etc.

The new rates just agreed upon are as follows, for any length of haul:

Stone, gravel and sand—½ cent per ton per mile with a $6.00 per car minimum, exclusive of mountain hauls.

Road oil and bituminous rock—¾ cents per ton per mile, minimum $10.00 per car.

Asphalt—1 cent per ton per mile, whether in tank, cars or packages. Minimum $10.00 per car.

All other commodities—(a) The lowest of any commercial rate or (b) ½ of any class rate. Minimum $10.00 per car.

The latter rate will include cement, steel, culvert pipe and other miscellaneous materials ,together with contractor's equipment when shipped marked California Highway Commission.

There are now 37½ miles of state highway under contract in widely separated parts of the state, and 58 miles more are now under advertisement, the bids to be opened during the last week of the present month.

On all the roads now advertised and awaiting contract, it is proposed to use a hydraulic cement concrete base 15 feet wide, covered with a thin surface of a bituminous mixture.

The counties have generously agreed to furnish such rights of way as are needed for re-locating the roads and the commission expects that none of the bridges of the state which are more than 20 ft. in span will have to be built with money from the highway fund. Thus far no county has refused to reconstruct such bridges or to build new ones when the commission has made the request.

Every effort is being made to have the main state highway routes completed before the great Exposition at San Francisco opens its doors in 1915.

CO-OPERATIVE PUBLICITY POSSIBILITIES.[1]

BY FRANK H. GALE.

Closely associated with what in these remarks we shall call publicity, is the subject of advertising, which, however allied it may be, will not occupy my attention at this time. For clearness, let us understand that in this discussion the term "advertising" shall refer to the use of paid space in publications of any kind and that "publicity" shall refer to educational work involving the preparation and distribution of reading matter suitable for use by editors and writers.

I need scarcely point out to you that publicity is, and always has been, a most potent factor and that its influence is growing stronger and stronger with the tremendous increase in the production and circulation of magazines and newspapers. Its value was fully appreciated by Barnum, who worked a corps of press agents overtime. The Standard Oil Company for many years maintained a policy of absolute silence to the press until its enemies, taking advantage of this attitude, began to circulate publicity unfavorable to the corporation. Then although somewhat tardily, in line with modern ideas and methods, they engaged a publicity man and adopted a liberal policy towards writer and editors.

This was also true of the railroads and other corporations but time has convinced them of their error and now little or no effort is being made to suppress such industrial news. It is always better to have the facts presented to the public rather than to earn the disfavor of every editor and to see the news distorted and abused because the writer had to use his imagination.

The managers of actors and theatres were quick to see the value of extensive press notices about a favorite actor, actress or play and soon by trickery and fraud, they were trying to keep names before the public by artificial means and so the old-fashioned press agent was born.

Following the theatrical press agent came a horde of press agents working in the interests of individuals, corporations and organizations of all sorts, until the poor editor found himself engaged in a constant fight against the schemes and strategies of able newspaper men who had determined to profit by the high salaries demanded by successful press agents. The thing was overdone and, quite naturally, it soon killed itself.

Much had been said and written of the rise and decline of the press agent. Publishers now maintain a thorough organization to defeat the efforts of the old-fashioned press agent. His race is run. This does not mean, however, that legitimate, so called "Free Publicity" for any individual, corporation or organization cannot still be secured. Nearly every newspaper or magazine which we see exemplifies in some way the truth of this statement.

The publicity man has taken the place of the old press agent. He is preferably a former newspaper man who thoroughly understands the newspaper "game" and knows what editors like to see and what people like to read. He knows that bad news travels on the wings of the morning and that good news usually needs a "pusher" on the up grades. An accident on his railroad, a strike in his factory, a disaster in his power house is recognized as news by the papers and will be published willy-nilly, whether he will or no. He therefore wisely lays all the facts before the public, very likely being able thereby to actually create a favorable impression for his company, for with this move he instantly earns the favor of every newspaper man, and in return they will see that his interests do not suffer.

The modern publicity man realizes that there is a great deal of valuable news connected with every industry in which the public is vitally interested, and it is his first duty to see that editors and writers have complete access to this information. He is naturally an expert on public opinion and in time becomes a sort of general utility man for the company.

It is quite impossible for newspaper men to invade the great industrial plants to secure this valuable news. In the mighty plans of today such news is not easily located and more than likely he would not understand the jargon of the trade if he did find it. Therefore it is the first duty of every publicity man to explain the technical terms and details of such a newspaper story until the ordinary writer and the still more ordinary reader can comprehend. This is especially true of the electrical industry as every one knows, has a language all its own. Newspaper men, writers and editors cannot translate and interpret these terms without assistance. How many times have electrical stories appeared in the daily press where the generator was made to run a turbine, and other electrical apparatus was made to perform equally impossible stunts. This can only be corrected by a thoroughly competent publicity man, who is familiar with both the electrical language and the needs of the press. Of course, publicity bureaus can in time, educate people until the vast majority will be able to understand and use these terms correctly.

This elementary educational work, the A, B, C's of electricity is necessary, and there is every evidence that the public is willing to learn. Following this come the general educational and news stories ever present with such a relatively and growing industry.

I am personally aware of many thousands of columns of newspaper space which have been devoted to this subject in America during the past few years, and have seen hundreds of magazine articles on the subject. The readiness with which editors accept articles and the frequency with which they are copied and re-copied, by other publications, indicate clearly a great interest on the part of the readers, but this appetite is not at all satisfied.

The lighting company in any city finds its local newspapers ready and willing to publish articles on electrical subjects but few of these companies can afford to maintain a department for preparing and supplying this material or have much time for this work. Of course, many such companies supply a local newspaper with information regarding their local activities, but more often than otherwise the only news

[Concluded on Page 242.]

[1]Paper presented at Commercial Session, Association Island, Sept. 13, 1912.

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POWER AND GAS

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

An Unjust Prohibitor

A most commendable service has been performed by the Board of Fire Underwriters in unifying the practice in electrical installations and wiring. The low insurance rates now existing in American cities is largely due to the high efficiency of their engineering department and to their rigid inspection methods. Their rulings have been incorporated in the building codes of many cities and their regulations are considered standard.

Consequently it is a matter of great regret that the city of San Francisco continues to withhold its sanction of the use of one of the most adaptable methods that engineering ingenuity has devised when this material has the full approval of the Underwriters' Laboratories, namely the use of flexible steel armored conductor on the same basis as rigid metallic conduit. The ban was placed on this practice under a former administration on account of the fact that it eliminated the necessity of drawing in the wire and consequently deprived the electricians of considerable work. Now that such methods have been discountenanced by the majority of the voters it seems no more than just that full approval should be granted to this material.

This matter has recently come to a head because the local inspector would not pass on the armored conductor extensions in the new home of the Great Western Power Company. Indirectly this action also places a premium on cheap and unsafe work in places where conduit construction is not mandatory and where its greater cost encourages knob and tube work. San Francisco is today the only American city which practically prohibits the use of steel armored conductors and flexible steel conduit in spite of the fact that this type of construction is on a parity with rigid pipes throughout the country.

The Electrical Industry and the Moving Picture

The whole world will stand still for a few minutes, if necessary, in order to watch human life in action, such creatures of habit are we. Perhaps never before in the ages of evolution has so potent an influence for education of the masses arisen in so short a time as has that of the moving picture machine. Life—throbbing life—confronts us on every hand in our daily existence. Hence it is not to be considered in the category of a miracle that the animated panoramic picture of this throbbing life should hold us all spell-bound in our hours of leisure or relaxation from keen business tension.

At the Seattle convention of the National Electric Light Association last June, the paper which held all spell-bound was that which told by means of moving pictures the story of the Northern Colorado Power Company and its efforts to spread broadcast the economic results to be attained by both power company and farmer in the application of electrical energy for the pumping of water upon the arid lands in their territory.

The story told by the speaker was simple and of

but a few words. The pictures themselves gave the finger marks of the amateur in their production, and yet the consensus of opinion of those present was that the evening passed in seeing the trials and tribulations of John Redman was the most enjoyable and instructive spent during the convention. Why was this? Because as one looked, he saw pictured human endeavor with its trials, its disappointments and its forebodings, finally crowned with success—a story so human, so realistic, so sympathetic and entuned with the daily struggles of all the listeners, it could not help but go home to the hearts of the hearers. Added to this was the life and action of John Redman and the other characters displayed vividly before the mental vision of all.

No one could see an exhibit such as this without taking to heart the potent influence the moving picture machine can be made to have in the advertising of the electrical industry. So new and so constantly changing are the applications of electrical energy, the public is always interested. Especially is this true of our rural communities. Here in the rural life of the arid sections of the West is to be eventually found the market for gigantic powers. The commercial departments of our great Western power companies would do well to exert considerable effort in the gathering of moving picture data illustrative of matter of human interest to those before whom they wish to make a display. If now the subject matter is of this human interest to the audience, the life and action brought out by the moving picture can not fail to hold every observer spellbound. Incidentally, too, in a truly painless manner the speaker will be able to carry home to the listener the great benefits to be derived by taking advantage of any use and opportunity offered by the proper application of electrical energy.

On another page of this issue is presented to our readers, a description of the Pacific Light & Power Company of Oregon. Here is a company occupying a territory of 20,000 sq. miles, which without the electrically operated pump would be a barren waste. Such illustrations as this, wherein 20,000 kw., installed capacity in electrically operated pumps, are raising to the surface the joy and substantial blessings of life are indeed typical of the new era ahead in the rural life of the arid but fertile West. Let us then, take in hand every weapon of publicity and by no means the least among them will be found the story as told by the moving picture machine.

The Status of Fuel Oil Consumption

New fields and new applications are constantly opening up for the consumption of crude petroleum. Two new ships of the navy, the battleships "Nevada" and "Oklahoma" are to burn fuel oil exclusively. These two men-of-war are the modern dreadnaughts of our prowess upon the seas and the use of fuel oil will mean a distinct advantage to them just as it has so proved to the merchant ships. In this particular instance fire-room weights have been reduced some 300 tons due to the decrease in the weight of fuel necessary for a given steaming radius. The fire-room force, too, has been reduced 50 per cent. Indeed, the navy officials seem by their actions to have become enthusiasts in oil fuel to the extent that 19 torpedo boat destroyers and 8 battleships already burn oil as an auxiliary to coal.

Western railroads have long since discovered the economies brought about by utilizing oil for their locomotives. The Southern Pacific uses over 1200 oil burning locomotives, the Santa Fe over 800, the Northern Pacific 200, and the Great Northern 115. So persistent is the onward impetus of oil as a fuel that we find its influence strongly felt in the neighboring states to California, even though large bodies of coal are found within easy reach. Some of the Washington coal mines, for instance, are within less than 50 miles of Puget Sound, yet most of the steamers plying in those waters are using oil for fuel.

So far as steam auxiliary supply for the great hydroelectric transmission systems of the West are concerned, the use of crude petroleum is now so standard, this commodity may well be defined as one of the necessary staples in approved Western hydroelectric power generation.

The production of petroleum in the United States for 1911 reached the enormous total valuation of $134,-044,752 as opposed to $625,910,113 worth of coal. Last year's production established a high record of 220,449,-391 barrels of 42 gallons each, valued at 60.8 cents per barrel. The total production of the world was 345,-000,000 barrels, so that the United States produced 63 per cent of the total. California was the largest producer, aggregating 81,000,000 barrels, followed by Oklahoma with 56,000,000 barrels. The prices per barrel ranged from 47 cents to $1.32 for Louisiana and Pennsylvania petroleum. The commercial quotations are $1.60 for Pennsylvania oil, $1.47 for Canadian, down to 55 cents for Caddo and Corsicana oils.

In contrast with the recent increase in crude oil prices is the steadiness or decrease in refining oils. The increased uses of crude petroleum in various types of internal combustion engines lessening in a measure the consumption of the refined product unquestionably are making their weight felt.

Another phase of the rise in use of the product of the oil fields is the rapid advance made in utilization of natural gas. Upon the heels of the construction work now rapidly being consummated in the installation of natural gas mains from the Bakersfield district into Los Angeles—a distance of 125 miles, comes the continued rumors of efforts being made to arouse interest in the transmission of this cheap commodity into San Francisco—a distance fully twice as far. Whether those engaged in the manufacture of oil gas do or do not desire this inroad into territory now served by the oil gas process makes little difference. The continued hammering of competition looking toward cheaper and more efficient service, demands a fair consideration of utilizing this enormous natural resource.

Viewed, then, from all of its varying ramifications, the crude petroleum industry is wonderful in its youth and promise and the West may confidently look forward to continued blessings from this great natural resource.

CO-OPERATIVE PUBLICITY POSSIBILITIES.

[Continued from Page 239.]

secured from local source is that which reporters themselves dig up, frequently in spite of the local lighting company rather than because of its co-operation.

The manufacturers, particularly the larger ones, doing business national in scope, can and do issue more or less material for publicity purposes. But editors are prone to consider the source of such information which renders the publicity task more difficult. Furthermore, it is natural for a manufacturer to consider only those phases of the industry in which he is interested submerging and destroying the news values.

This situation, therefore, points largely to the value of an independent publicity organization supported by the industry at large. Such an organization must observe strictly the trade ethics in planning publicity either for newspapers magazines, or technical papers. The violation of a few simple rules will insure the failure of the desired publicity.

Publications should not be expected to print advertising matter free of charge. Nothing but straight, legitimate news and good educational matter should be supplied.

Publicity should never be considered in connection with advertising space. No publishers should be approached with a proposition to insert a small advertisement and give a large free news article on the subject. If the material is something the readers will like, the editor will be glad to publish it. Petty tricks and disthonesty should never be resorted to for the sake of a few lines of free publicity.

The electrical industry is today the most fertile field of all publicity work. Great inventions, new methods, enormous undertakings, novel installations and the prominent part taken by electricity in the wonderful progress today all offer abundant material for the publicity man working in the interest of the industry at large.

One other word—material supplied by this publicity bureau must be written in an entertaining way without technical terms. There is an abundance of technical literature available but a scarcity of that which the layman can understand.

The publicity bureau under consideration should come out into the open and should endeavor to be recognized by writers and editors everywhere as a source or reliable news on electrical subjects. It should be especially equipped for furnishing data to free lance writers of which there are many in the country at present interested in the subject of electricity. It should be prepared to supply notes on electrical subjects for use by local lighting companies, whenever they are themselves unable to keep their local editors supplied with sufficient material of that sort.

I should have perhaps placed first in the duties of this bureau the work in connection with the so-called people's electrical page, about 40 of which are now being published in various cities about the country. This local co-operative electrical page has great local advertising value, but its success depends upon the quality of the material published as reading matter. A certain part of this space should be devoted to local electrical notes; but there is no reason why a considerable part of it should not be supplied from a central bureau and there is certainly no objection to the same matter appearing simultaneously in the electrical pages published in all the different cities.

Preparations of such material can be easily handled by a central bureau.

A co-operative publicity bureau should undertake the management of these electrical pages in all of the different cities, maintaining a traveling representative who could personally keep in touch with each situation, thus adding the personal stimulus which is some times necessary to keep such movements alive. This would solve many of the problems which arise when such pages are first launched.

While the bureau could and should be of very great help in organizing and conducting these electrical pages, it should not in my opinion, be called upon for financial support for such pages. One great value of the local electrical page is a stimulus for closer co-operation among local electrical interests and this is at once removed when outside financial support is accepted.

If a central publicity bureau should be formed for only the sole purpose of assisting in the formation and management of these local people's electrical pages, it would undoubtedly be of great value to the industry.

A further possibility for such a bureau to extend its services would lie in the opportunity for furnishing regular electrical news items of value to the household columns of women's magazines. It might also prepare articles of real interest which would be acceptable to popular magazines.

Such a publicity bureau would also naturally cooperate closely with the electrical press and the bulletins of various organizations, local and national, interested in the electrical industry from any standpoint.

Summing up, as I see it, a co-operative publicity bureau would be able to supplement in a very effective way the work at present carried on to a greater extent by lighting companies dealers, jobbers and manufacturers, and without interfering in any way with their efforts would be able to distribute to the reading public a vast amount of educational material on the subject of electricity which in due time would not fail to increase the general interest in the use of electricity, and thereby become profitable to all of us.

JAPANESE ELECTRIC CONSOLIDATION.

The three electric light enterprises of the Japanese capital, the Tokyo Electric Light Company, the Municipal Electric Light Company, and the Nippon Electric Light Company, are to be united and the supply of power will be obtained from the Katsura River.

OIL FUEL IN SIAM.

The Meklong Railway Company (Ltd.) of Siam, is about to experiment with an engine burning both firewood and oil.

PERSONALS.

H. W. Crozier of Sanderson & Porter is in Arizona.

C. L. Cory has just returned to San Francisco from a trip to Salt Lake City.

Wynn Meredith, of Sanderson & Porter's Pacific Coast department, is spending two weeks in the Pacific Northwest.

Geo. C. Holberton, San Francisco manager for the Pacific Gas & Electric Company, is making an extensive trip throughout the East.

A. H. Halloran, managing editor of this journal, is attending the convention of the Northwest Electric Light and Power Association at Portland.

H. R. Noack, president of Pierson, Roeding & Co., has returned to San Francisco, after spending several days at Los Angeles on business.

George R. Murphy, head of the storage battery department of Pierson, Roeding & Co., became the proud father of a daughter on Admission Day.

W. E. Luman, purchasing agent for the Northern Electric Railway Company, with headquarters at Chico, is among the recent arrivals at San Francisco.

C. W. Forbes, general manager of the Compania Telefonica de Sonora, with headquarters at Hermosillo, Mexico, is at San Francisco on business.

Russell H. Ballard, secretary and assistant general manager of the Southern California Edison Company, is at San Francisco accompanied by his family.

J. G. Pomeroy has resigned as sales manager of the Adams-Bagnall Company of Cleveland, Ohio, and will spend the winter months in Southern California.

A. L. Snyder, connected with the engineering staff of the Stone & Webster Construction Company, left Los Angeles during the past week on a hurried trip to Boston.

W. H. Wissing has resigned as manager of the new business department of the San Francisco and Sierra Power Company to undertake similar work for the Oro Electric Corporation of San Francisco.

Nathaniel A. Carle, of Seattle, Wash., has been appointed chief engineer of the Public Service Corporation of New Jersey. Mr. Carle is now in Newark and will assume his duties at once. The new chief engineer is a graduate of Stanford University.

H. H. Noble, president of the Northern California Power Company, is making an extensive eastern tour. On September 10th, at Augusta, he attended the fiftieth anniversary of the Twenty-first Maine Regiment on the drill grounds on which he was mustered in for the Civil War.

J. A. MacMonnies, head of the appliance department of the Great Western Power Company, has returned to San Francisco after an instructive Eastern tour. **W. F. Neiman,** one of the general sales managers of the company, has returned from an Eastern trip, covering central stations at New York, Chicago, Rochester, and elsewhere.

F. H. Leggett, who was formerly foreign sales manager of the Western Electric Company, with headquarters at New York, has arrived at San Farncisco to take charge of the Pacific Coast department. He relieves **F. B. Gleason,** who will leave the latter part of September for Tokio, as Far Eastern manager for the Western Electric.

Ross B. Mateer has been appointed manager of the agricultural sales department of the Great Western Power Company with headquarters at San Francisco. He has general charge of the irrigation pumping business and other applications of electric power in connection with farming. Before coming here Mateer was manager of the power sales department of the Denver Gas and Electric Company.

T. L. Billingsley has resigned his position with the Washington Water Power Company of Spokane to become general superintendent of the Portland, Eugene & Eastern Railway, which is to operate in the Willamette Valley. Superintendent Billingsley will have direct charge of the streetcar systems at Salem, Albany and Eugene, as well as the various connecting lines to be constructed immediately, including the electrification of the old west side steam tracks of the Southern Pacific Company, the new Molalla-Canby-Silverton division and the connection between Corvallis and Eugene, by way of Monroe. Mr. Billingsley is already located at Salem, where he will establish his headquarters.

ELECTRICAL DEVELOPMENT LEAGUE.

An enthusiastic meeting of the Electrical Development League was held at Tait's Cafe, September 10th, at 12:15, with an attendance of sixty members. W. W. Briggs presented an excellent paper on the "Latent Possibilities of the League," which will be published in these columns next week.

SAN FRANCISCO REJUVENATION.

A most successful rejuvenation of the Sons of Jove, the electrical fraternity, was held at San Francisco on September 10 in the hall of the Elk's Club. The degree team did the work in a most finished manner with elaborate costumes and many brilliant accessories, being as follows:

Jupiter, A. E. Drendell	Avrenim, Fred Poss
Neptune, C. C. Hillis	Mercury W. W. Hanscom
Vulcan, T. E. Bibbins	Imps, H. Woodward
Pluto, M. L. Scobie	W. R. Dunbar
Hercules, John R. Cole	J. A. Herr
Mars, A. H. Halloran	L. Levy
Apollo, G. I. Kinney	Ed. Hand

The candidates were as follows:

P. H. Affolter	J. E. Drendell	A. L. Myers
G. A. Anderson	L. Gaertner	W. F. Neiman
S. B. Anderson	H. E. H. Grant	E. A. Norton
G. L. Bayley	W. A. Gribble	J. W. Redpath
H. E. Bittmann	L. M. Hardie	W. H. Seaver
W. A. Blair	A. Z. Hirsch	F. O. Sievers
A. T. Brown	A. F. Holmes	H. B. Squires
E. E. Browne	C. W. Hutton	G. A. Sittman
L. J. Brown	P. B. Hyde	L. A. Thatcher
W. E. Camp	H. F. Jackson	F. S. Trumbull
L. C. Cravens	H. B. Jensen	A. R. Wertheimer
G. H. Curtiss	A. Kahn	R. A. Wolden
H. H. Daly	J. A. MacMonnies	J. E. Woodbridge
P. Decker	C. W. Mitchell	H. J. Zweifel Jr.

An enjoyable Dutch lunch was served after the initiation. Particular credit is due to the "flying legion" for their energy in getting the large number of candidates which graced this initiation.

TRADE NOTES.

George J. Henry Jr. is furnishing two tangential water wheels for the Utah Power, Light & Railway Company, to be direct connected to generators supplying current for Salt Lake City and Ogden. The generating unit for the power station near Salt Lake City is of 1500 h.p. capacity and for the Ogden plant 1750 h.p.

The Kellogg Switchboard & Supply Company has sold to the United Farmers Telephone & Telegraph Company of Gardnerville, Nev., complete magneto telephone equipment for about 250 subscribers. The system will serve the Carson Valley and will connect with the long distance lines of the Pacific Telephone & Telegraph Company.

The plans and specifications for the electric lighting system of the Panama-Pacific Exposition are so far advanced that bids may be called for within the next thirty days. It is estimated that about three million dollars will be expended on engineering work, including underground conduits for light and power ducts, water supply, sewers, and fire protection system. It is understood that the exteriors of the Exposition buildings will be illuminated principally by concealed lighting effects that will give a soft brilliance and ample illumination.

WHAT CO-OPERATIVE EFFORT CAN DO FOR THE CONTRACTORS.[1]

BY EARNEST FREEMAN.

It was my privilege a number of years ago to witness a practical demonstration of a retail merchant teaching his clerks how he wished them to conduct themselves during business hours. There were four clerks in the store and the scene took place in the afternoon prior to opening day. The four clerks were taken to a lot in the vicinity on which was a rather high peaked roof building, over which the merchant had thrown a rope of sufficient length to touch the ground at either end and with perhaps ten foot to spare. The clerks were then directed to take hold of the rope, two on each end and were instructed to see which side could pull the rope away from the other, they being carefully cautioned to pull fair, not to take any undue advantage nor to attempt sharp tricks so that the contest might be one simply of strength and endurance. The pull was started, first one side and then the other from time to time getting a little advantage—one side would get a little start and almost win when with some extraordinary pull this advantage would be overcome and so this was waged with no indication of success, when suddenly one side commenced to cheat—commence to take unfair advantage and to attempt unscrupulous methods—they would try to hitch the rope under some hook on the side of the building, tried to wind themselves up in the lower end and gain inch by inch, all of which sharp practices was quickly stopped by the merchant, but try as they would by fair means nor by foul could either side win. Finally both sides were directed to discontinue—the rope was readjusted to its original portion and all four of the clerks were placed on one side and told to lay hold and all pull at the same time, the result of which was that the rope was all over on their side without scarcely an effort. The merchant then explained that he hopes in all their acts and duties so long as they were with him would be handled on the team work plan, cautioning them that no permanent gains would be had by dishonest and unfair means. The merchant choose to call this pulling together. If the words "Co-operation" means the same to we who are assembled here today as the words "pulling together" meant to the merchant, I am for it, and the National Electrical Contractors' Association is for it .

As a result of this kind of pulling together or co-operation, I can see the Electrical Contractor coming into his rights but I am unwilling to admit that the results would be any more beneficial to the contractor than to the manufacturer, jobber or central station.

It is my belief that the electrical contractor of today is in better position than ever before—I feel that his general condition is improved and I am convinced he is a bigger business man and I am also persuaded that through his associations and by his own personal push, he is slowly but nevertheless steadily coming into his own.

But, by pulling together, by co-operation, by all operating jointly to the same end, I can see ripened into reality things which in the past have been but dreams and at a much more rapid pace.

By the joint publication of such periodicals as the "Electrical Equipment of the Home," and the "Home Beautiful," I can see that the suggestions contained therein will tend to create a desire for the mentioned conveniences the installation of which will increase the business of the contractor.

I can see in "Co-operative Publicity" the building of a feeling in the minds of the public tending towards greater confidence—confidence both in safety to the individual user and safety to the general masses. I can also see a chance by this method of showing the consumer that electricity is the best of all methods for illumination, best of all methods for laundry work, best of all methods for cooking and hundreds of other things and that the electric motor will operate the factory not only with greater efficiency in the working force and superior output but with greater economy than other known power and I can see that the contractor will come in for his share of increased business as a result of such methods as these.

And following this line of thought—if general publicity creates a demand for one product, certain it is to my mind at least, that the contractor who fails to avail himself of the opportunities offered by the "People's Electrical Page" is indeed making a mistake. It seems to me that this is the place for the men in my line to spend money, because if a demand is created, or a desire is instilled into the public mind for electrical apparatus, the contractor must let it be known who he is and what he is in order that these demands and desires may be gratified. Certain it is that the contractor is the most feasible one to look to or these things, and it, therefore, behooves him to the limit in taking space in co-operative newspaper advertising.

Let us go out and get better acquainted with our competitor, with our jobber, with our manufacturer, with our central station man and let us see if we cannot get to know one another well enough to call each other by our first name—this can be done by inaugurating luncheon or harmony clubs and I think it has been found to be a fact that where such interests have gotten together that each has found the other to be a pretty good fellow after all and much good has naturally followed.

The electrical contractor is for all these things because he can see in them a brighter and better future, because he can see the possibilities of a larger business and because he wants to be in any and all movements tending to advance the electrical field as a whole and we therefore, offer you our influence, our support and our money.

[1]Paper presented at Commercial Session, Association Island, Sept. 13, 1912.

REVISION OF RULES ON INSTALLATION IN BUILDINGS OF TRANSFORMERS HAVING OIL-FILLED CASES.

The Board of Fire Underwriters of the Pacific have recently revised the rules on the installation of transformers with oil-filled cases as follows: All transformer installations in buildings shall be in accordance with Rule 45 of the 1911 National Electrical Code, as stated below:

> 45. TRANSFORMERS, (When permitted inside buildings)—Transformers must not be placed inside buildings without special permission from the Inspection Department having jurisdiction.
>
> (a) Must be located as near as possible to the point at which the primary wires enter the building.
>
> (b) Must be placed in an enclosure constructed of fire-resisting material; the enclosure to be used only for this purpose, and to be kept securely locked, and access to the same allowed only to responsible parties.
>
> (c) Must be thoroughly insulated from the ground, or permanently and effectually grounded, and the enclosure in which they are placed must be practically air-tight, except that it must be thoroughly ventilated to the outdoor air, if possible through a chimney or flue. There should be at least six inches air space on all sides of the transformer.

To comply with sections "B" and "C" of the above rule, the enclosure must have a concrete floor at least three (3) inches thick and the walls must be of brick or concrete. If made of concrete, reinforced according to the rules of good practice the walls must be at least four (4) inches thick; if of concrete not reinforced, they must be at least six (6) inches thick, and if of brick, they must be at least eight (8) inches thick. The covering of the enclosure must be made of concrete or other fire-resisting material, such as sheet steel or tile. The vent must be through an opening having a cross-sectional area of at least thirty-six (36) square inches.

The enclosure must be entirely cut off from any other part of the building and access to it must be from the outside of the building.

NEWS NOTES

INCORPORATIONS.

RIVERSIDE, CAL.—Purchasers of Highland Home ranch at Beaumont have organized the Glen Eyrie Water Company and will develop water for lands in Beaumont foothills. The company has authorized capital of $31,500. Directors: A. Adair, C. L. Nye and Frank C. Nye.

ILLUMINATION.

LOS ANGELES, CAL.—The Board of Supervisors have created the Laurel Canyon Lighting District.

LOS ANGELES, CAL.—A patent for a new electric lighting system, the invention of A. J. Austin, 711 Westlake avenue, has just been issued, papers being received, according to Mr. Austin.

COLTON, CAL.—The Southern California Gas Company is now building two large pipe lines from Kern County to Los Angeles. As soon as possible after this line is in operation to Los Angeles, a high pressure line will be built east from Los Angeles to Pomona, Ontario and Colton.

CHEHALIS, WASH.—Napavine is to have electricity from the plant of the Washington-Oregon Corporation at Chehalis. The town gets five free electric lights during the life of a twenty-five year franchise, and after the first two years the Independent Electric Company, to whom the franchise was granted, will pay $15 per month to Lewis County for use of its right-of-way over the county roads.

MARYSVILLE, CAL.—Both the proposition of the Pacific Gas & Electric Company to enter into a five-year contract with the city of Marysville for furnishing the municipality with light and power at reduced rates and the request of the Oro Light & Power Company that the awarding of any such contract be postponed for a period of at least a year, to give them time to enter the local field, have been laid over indefinitely by the City Council.

SAN FRANCISCO, CAL.—The Railroad Commission has rendered a decision granting permission to the Central California Gas Company to increase its authorized bonded indebtedness from $200,000 to $500,000 and to change the maturity of its bonds from forty to twenty years. The company in the application just passed upon, did not ask for permission to sell additional bonds. This matter is now before the Commission in a subsequent application filed by the Central California Gas Company.

PALO ALTO, CAL.—The city of Palo Alto has filed with the Railroad Commission its answer rejecting the proffered settlement of the Palo Alto Gas Company of the complaint recently brought on behalf of the city of Palo Alto. The city protested against the $1.50 gas rate. The gas company, in reply, offered to compromise with either a flat rate of $1.40 or a sliding scale rate from $1.45 down to $1.25. The city petitions that the original complaint go to trial so that the Commission may fix a rate.

SAN FRANCISCO, CAL.—The Indian Valley Electric Light and Power Company has submitted to the Railroad Commission an amended application asking for permission to issue $250,000 in bonds. The company states that it neglected at the hearing to submit the evidence upon which it relied for the authorization of a bond issue, and that it desires now to submit that evidence to the Commission. The Indian Valley company operates in Plumas County.

FLORENCE, ORE.—Current has been turned on from the plant of the Florence Electric Company. Several buildings have already been wired and more wiring is being done as fast as the men can work. At present the plant is in a temporary wooden building, but a concrete structure will be erected in a short time. It is understood here that Porter Bros. have purchased the stock of the Hurd Lumber & Navigation Company's store and will distribute it to the commissary departments of their various railroad construction camps.

TRANSPORTATION.

SEATTLE, WASH.—An ordinance has been passed by the council to compel the extension of the East Union street car line.

SAN JOSE, CAL.—The Peninsular Railway Company has presented a petition asking the Council to advertise for sale a franchise for a double-track standard-gauge electric railroad or that portion of the Alameda road recently annexed to the city.

TULARE, CAL.—With no one to oppose their bid at the meeting of the Board of Trustees, the Big Four Electric Railroad was awarded the franchise which was applied for several weeks ago and which gives them the privilege on certain streets in this city.

SUISUN, CAL.—The Railroad Commission has granted an order allowing the Vallejo & Northern Railroad to construct its main line track at grade across streets and highways in the cities of Suisun, Fairfield and Vacaville, in Solano County, and also across intervening public highways.

CALISTOGA, CAL.—Upwards of a thousand guests were here Monday from San Francisco, Vallejo, St. Helena and near-by towns, the occasion being the entry of the first train of the San Francisco-Napa Valley Electric Railroad, which has just been completed. The new line runs from St. Helena, a distance of nine miles, and means the opening and rapid development of this region before 1915.

LOS ANGELES, CAL.—The Harbor Commission passed a resolution recommending the following tentative plan for the general control of the proposed municipal railway to the harbor, by way of San Pedro: That the Los Angeles Municipal Railroad & Terminal Company be incorporated for $5,000,000, to be owned by the city, bonds to be issued in the sum of $2,500,000 and offered to the general public for sale. The bonds are to bear 5 per cent interest.

SALT LAKE CITY, UTAH.—Within 30 days construction work will begin on a 61-mile interurban electric road from Salt Lake City to Payson in Utah County, touching at the more important towns en route. This announcement was made following the passage of an ordinance by the city commission granting to Abel J. Evans and his associates a franchise to use certain streets for the construction of the road into Salt Lake City. A $3,000,000 contract for the construction has been let to the A. J. Orem Company of this city which represents Boston capital. The new road will connect at Salt Lake with the Salt Lake & Oregon Railway by means of a union depot to be built up town, and through a further connection with the Ogden Rapid Transit Company will effect an unbroken chain of electric railway from Bingham City on the north to Payson on the south, a stretch of approximity 120 miles through the heart of Utah. Other than Evans the promoters are Simon Bamberger president of the Salt Lake & Ogden; W. R. Wallace, W. W. Armstrong and several other men prominent in Utah County.

SAN FRANCISCO, CAL.—J. W. Riess, vice-president of the W. J. Holman Company, which holds the contract for the construction of the cars for the Geary street municipal railroad, called before the Board of Works last week to tell why his firm would not be able to complete the manufacture of the forty-three cars and four extra trucks, required for

the operation of the road by December 8, the time limit stipulated in the contract. He informed the board that it would be possible to complete ten cars in October and ten more in December, making 20 within a short time after the road is expected to be ready to operate. He thought that this might be a sufficient number to operate the road from Kearny street to 33d avenue on a three-minute headway. Called upon to explain his delay, Riess said that he had realized before signing the contract that the cars could not be built within the required time, and that he had asked then that the 180-day limit be extended. He claimed to have a verbal understanding that if he showed the proper spirit in trying to complete the task his firm would, in all probability, be given an extension of time. Assistant City Attorney O'Brien held that only three avenues were open to the contractor, namely, to complete the contract on time, to default on it and forfeit $100,000 bond, or else to secure the extension. Reiss said that ten cars will be delivered October 25 ten by December 24, 11 by February 20, 1913, and the remaining 12 by April 10, 1913. The Board ordered Reis to furnish it with copies of the daily report on progress of work furnished by the inspectors watching construction.

TRANSMISSION.

PHOENIX, ARIZ.—The City Council has agreed to accept the terms of the Government contract in which it will furnish electricity to the city at a rate of 5½ cents per kilowatt hour.

VENTURA, CAL.—Notice is hereby given that Ojai Power Company has applied for a franchise granting right to construct and maintain poles, posts, wires, cables, etc., to transmit electrical power upon the highways of Ventura County.

WILLOWS, CAL.—The Northern California Power Company is putting in poles from Maxwell north to the Spalding ranch to carry the new high power line which will furnish electricity to run motors for pumping water from the Spalding irrigation wells.

SACRAMENTO, CAL.—In a supplemental order the Railroad Commission permitted the Northern California Power Company to expend the full proceeds of the sale of its $500,000 of 5 per cent debenture notes. These notes were sold at $96 to a coterie of Swiss bankers and the $480,000 thus realized will be distributed as follows: $315,133.66 to pay claims properly chargeable to operating expenses, the Commission having satisfied itself that a greater sum than this had been expended by the company from income for the construction of additions to its plant, without having been reimbursed through an issuance of stocks, bonds, or other evidences of indebtedness; $164,886.34 representing obligations contracted for the purchase of material or services rendered in connection with additions to plant.

TELEPHONE AND TELEGRAPH.

TEKOA, WASH.—W. N. Anderson of Rosalia has purchased the Tekoa local exchange of the Pacific States Telephone & Telegraph Company.

GOLDFIELD, NEV.—Reno, Winnemucca, Tonopah, and Goldfield are to be made stations on the Federal Wireless Telegraph Company's system, according to report.

NEEDLES, CAL.—The Needles Gas & Electric Company has purchased the local telephone system of the Arizona, California & Nevada Company. A general overhauling of the system is needed.

SANTA MARIA, CAL.—The Pacific Telephone & Telegraph Company has been granted a franchise to erect poles, wires and other conductors for transmission of electricity upon highways of Santa Maria.

IDAHO FALLS, IDAHO.—Construction work on the rural lines out of Idaho Falls will begin immediately, according to Earl S. Taylor, a special representative of the Mountain States Telephone & Telegraph Company, now in the city.

SAN RAFAEL, CAL.—The Marconi Wireless Telegraph Company of America with offices in the Phelan Building, San Francisco, are closing a $25,000 deal in a ranch near Bolinas for a site for a wireless station. It is the intention of the company to expend about $150,000 on the subject.

HOLBROOK, ARIZ.—A deal has been made here between Wm. B. Woods, Lloyd C. Henning and Fred W. Nelson and the Mountain States Telephone & Telegraph Company, whereby all of the holdings of that company in Navajo and Apache Counties passed into the hands and control of the above named men.

WATERWORKS.

FULLERTON, CAL.—The proposition calling for issue of $80,000 worth of bonds for acquiring municipal water plant was carried. Voters also approved the $132,000 bond issue for paving 31 miles of streets.

SAN DIEGO, CAL.—It would cost approximately $1,000,000 to develop the Cuyamaca water system to its full possibilities of water collection and distribution, according to William S. Post, consulting engineer of the company.

JACKSON, CAL.—A $20,000 mortgage, dated June 28, 1911, by the Mokelumne River Power Company to George C. Bruce and others, on 66,000 inches of water in the Mokelumne River watershed was filed for record here this week. Some of the water power sites concerned are now in litigation.

SAN DIEGO, CAL.—The fact that the State Railroad Commission has not yet passed on the rights of the Southern California Mountain Water Company to transfer its system to the city for right of municipality, does not affect preparations by the Council to go ahead with details of advertising the $2,500,000 bonds for sale.

SANTA MARIA, CAL.—An application has been filed with the Railroad Commission by the Domestic Water Company of Santa Maria, for permission to issue 250 shares of stock at $100 a share and bonds to the amount of $100,000. It is proposed to issue $75,000 in bonds and at a later date the remaining $30,000. A portion of the money is to be devoted to the purchase of the Santa Maria Water Company and the balance will be used in extending the system.

GRESHAM, ORE.—A private water system is being installed at Ventura Park, down on the Base Line road, that is intended to supply that new and fast growing community with water. A well was recently sunk a few feet from the Base Line and its waters were found to be of the very best. A pressure tank system is being installed, which is something new in water systems, but the tank is a big one and will furnish an unfailing supply of water for a thousand homes.

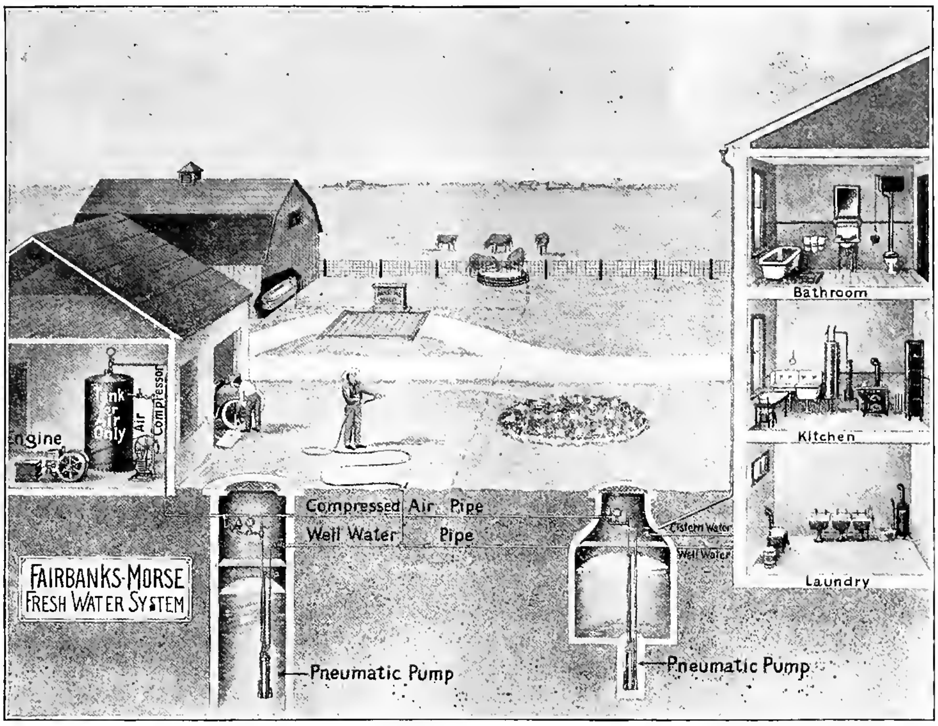
BAKER, ORE.—A report for the new municipal pipe line of this city was made by retiring City Engineer J. W. Bailey and his assistant, W. W. Atwater. The line which is now completed, has cost the city approximately $100,000 and is eight and one-quarter miles long. The remaining part which is more than six miles in length needs rebuilding, which will incur an additional expenditure of over $100,000. Another $100,000 is needed for the extension of pipe to the city water rights farther on.

OROVILLE, CAL.—An appropriation of 49,000 inches of water in the Middle Fork of the Feather River, the south branch of the Middle Fork and on Fall River has been filed with the county recorder by F. G. Ebey, S. H. Whisher and L. F. Bruener of San Francisco and Oakland. The formal record of the appropriation states that the water is to be used in one system for the purpose of generating electric power. The appropriation is the largest that has been made for many months in Butte County. It is stated in the articles of appropriation that it is estimated that 80,000 h.p. can be generated in the system that it is intended to construct. The power house itself is to be erected at a point on the Middle Fork, where the water will have a fall of 650 feet.

INDUSTRIAL

WATER SUPPLY SYSTEMS IN THE FARM HOME.

Water systems as now offered for private installations give ample opportunity to secure apparatus that is dependable and that can be secured for a reasonable outlay. One of the most popular types marketed is known as the Fresh Water System, so called because with it water is delivered "fresh" from the well to the faucet. This system will always have preference where convenience and flexibility are given first consideration. It is, in fact, the most modern method of water delivery under pressure and gives service fully equal to and in most cases surpassing that available in the city. For instance, it is not at all infrequent to find these systems supplying water from well or spring for drinking purposes; from a cistern for domestic use; and from one or more additional wells for stock and general purpose use, and all operated by only one power plant. This fresh water system is available when the water does not have to be elevated more than 100 feet and the water is clean, free from sand, grit and other impurities.



These plants consists of an air compressor which may be driven by a small gasoline engine or electric motor, an air-tight steel tank for air storage and an auto-pneumatic pump for each source of water supply. These pumps consist of two small metallic chambers which are submerged in the water. When a faucet is opened they automatically fill and discharge due to the compressed air pressure from the storage tank, thus giving a continuous flow of water. In addition to the strong feature of water being delivered fresh and cool an advantage of this system is that since compressed air can be piped most any distance to the auto-pneumatic pump in the well without any appreciable loss, the power plant, and air storage tank can be located wherever convenient, as in barn, garage or dry basement. This makes it an easy matter where an engine is used, to arrange to have it drive other machinery when not in use for pumping water.

For the benefit of our readers who may be interested to know something of the engineering problem in connection with water systems we give below a table showing the amount of water, in gallons, that can be drawn from faucets by auto-pneumatic pumps at various working pressures by the expansion of compressed air from a 1000 gallon air tank. To make this table of greater value an estimate of the amount of water used for various purposes on the farm is also given.

Pumping Capacity of Air Tanks.

Working Pressure on Pump Gauge.	Total Pressure in Tank at Start.						
	40 lbs.	50 lbs.	60 lbs.	70 lbs.	80 lbs.	90 lbs.	100 lbs
25 lbs.	375.	595.	833.	1075.	1310.	1548.	1786.
30 lbs.	221.	442.	663.	884.	1105.	1326.	1548.
35 lbs.	102.	306.	510.	714.	924.	1123.	1327.
40 lbs.	....	187.	374.	561.	748.	936.	1123.
45 lbs.	....	85.	255.	425.	596.	765.	936.
50 lbs.	....	....	153.	306.	460.	612.	765.
55 lbs.	....	....	68.	204.	330.	476.	612.
60 lbs.	....	....	....	119.	237.	375.	476.
65 lbs.	....	....	....	51.	153.	255.	357.

For air tanks of other than 1000 gallons capacity, divide the above figures by 1000 (move decimal point three places to the left) and multiply result by number of gallons the tank holds.

It takes .43 lb. pressure per sq. in. for every foot that water is forced upward in a standpipe or elevated tank. For instance, if water is forced 20 ft. high, $20 \times .43 = 8.6$ lb. pressure per sq. in. is secured; 40 ft. high gives 17.3 lb. pressure; 60 ft. high, 25.8 lb. pressure.

Reversing the foregoing proposition, every pound pressure per sq. in. in a service pipe elevates water 2.31 ft. high. If there are 15 lb. pressure per sq. in, in the service pipe, the water will be elevated $2.31 \times 15 = 34.65$ ft. high; 25 lb. pressure elevates water 57.75 ft. high; 35 lb. 80.85 ft. high, etc.

Amount of water required for stock and other purposes.

Horses drink 5 to 10 gallons per day. Cattle drink 7 to 12 gallons per day. Hogs drink 2 to 2½ gallons per day. Sheep drink 1 to 2 gallons per day. With 40 to 50 lb. pressure per sq. in., an ordinary ¾ in. garden hose nozzle re-

quires about 6 gallons per minute, when throwing a solid stream, or about 4 gallons when spraying. It requires about 8 gallons to sprinkle 100 sq. ft. of lawn; 16 to 20 gallons will soak it thoroughly. It required about 1½ gallons to fill an ordinary lavatory; 30 gallons fill the average bath tub. It requires about 7 to 10 gals. to flush a closet; 300 gallons is a fair estimate of the amount of water required by the average sized family in 24 hours.

Only power driven outfits should be considered where any considerable amount of water is to be used. In this connection it may be stated that the amount of water used for general purposes will be greatly increased when the water supply system is put in service. This does not imply that a family will be extravagant in the use of water merely because it is easily obtained. It means that all too small an amount is used where the family depends on other methods. In addition to a plentiful use of water for domestic use and for proper stock watering it is obvious that much will, if available, be used for other needs. Thus the garden will not be allowed to perish in case of drought nor will lawns and flower beds be permitted to die down in the summer.

Where one desires to draw water from a single well, or from a well or cistern the pneumatic tank method is frequently used. In this case water is pumped into an air-tight tank the compressive force on the air serving to force the water to the taps.

Regardless of the system selected a hand operated outfit should not be considered unless the water to be used is confined to purely domestic purposes. A considerable amount of physical energy is required to get a supply of water stored under a pressure of from 60 to 70 lb. As fire protection is one of the great features in favor of water pressure systems it will readily be seen that low pressure outfits are not advisable. Where water from cistern for bathroom, sink, etc., is all that is to be pumped a hand outfit may be found satisfactory. It is not at all fitted for service where stock watering, lawn sprinkling, carriage washing and similar purposes are to be served.

The plan of a new house should invariably incorporate a water system even though the installation of the system is not to be made immediately. In the same way in the selection of a kitchen range or furnace, it should be seen to that the firebox has pipes for water heating or at least so arranged that these may easily be put in place. Heating from the range is in a measure more satisfactory than from a furnace as the range is more likely to be used the year round. Plans for the barn should also be made with a view to having water brought into the building as inclement weather makes caring for stock a hardship. This is especially true during the severe weather of winter. With a water pressure system it becomes an easy matter to fit up a tank in all buildings where animals are kept so that stock can be watered without exposure.

COPPER MARKET SITUATION.

Activity in the domestic copper market recently was on a reduced scale, but notwithstanding that fact there is a degree of firmness apparent which is taken to indicate that the higher prices now established have probably come to stay for sometime to come. There is nothing in the immediate situation to warrant any other conclusion, and with a heavy consumption in the principal countries of the world the adequate metal necessary for manufacturing requirements is of such large proportions as to furnish effective support to prevailing values.

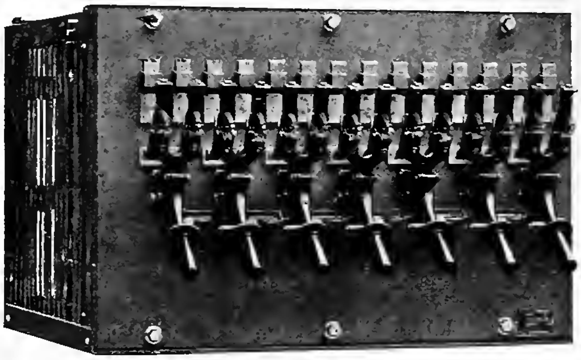
Although the buying in the American market lately has not been specially heavy, there were some fair-sized requirements to meet during the past 30 days. The very cheap lots so noticeable in July have largely if not entirely disappeared. There is less selling pressure from outside holders, and consequently quotations for electrolytic wirebars are fairly well maintained at 17¾ cents.

Recent local interests were centered on the monthly statistics compiled by the Producers Association for July. The increase in refinery production was surprisingly large last month, and the deduction from the last copper statement is that refinery output is capable of scoring some very erratic records. Following the appearance of the copper statistics London copper declined over a pound in value. Foreign operators evidently tried to manipulate the market for lower levels, but the firm front presented by the leading holders here checked the bearish tendencies of trades abroad.

The movement of copper into consumption is impressively great and likely to increase, but a sudden jump of nearly fifteen millions of pounds increased production at the refineries of the United States in July in comparison with the June output is an object lesson worth noting. It is a public intimation that on the basis of production for last month the output of marketable copper at that rate for a year would reach the enormous total of 1,645,933,548 pounds, against 1,431,938,338 pounds for the year 1911, an increase of 213,995,210 pounds. It is hardly probable that production by refineries will be maintained throughout the next twelve months at the same extraordinary rate of that of July. But a new record of output at refineries has been made, and the practical guarantee is thereby given that supplies will be less stringent than ever before. Consumption therefore will require to keep up with production to avoid an accumulation of supplies. The question is, can demand expand as rapidly as production? It is certain the copper situation is facing an important test of its strength.

NEW MULTIPLE SWITCH STARTER.

The Cutler-Hammer Manufacturing Company of Milwaukee has standardized, in sizes of from 60 to 600 h.p. a multiple switch starter for slip-ring induction motors. This type of starter handles rotor currents and separate quick-break switches are used for cutting out successive steps of resistance. The operating levers of these switches are interlocked so that it is impossible to close them except in the proper order. The lever at the left is first pushed down, closing the switch, and the closing of the second holds the first in the closed position. Closing the third holds the first two, and so on. Tripping the last switch, either by means of a no-



New Multiple Switch Starter.

voltage release or by hand, throws all the switches open, inserting the resistance again for starting. The time required to close the switches, one after the other, is desirable, as it prevents too rapid acceleration of the motor. Another feature is that with this type of starter part of the resistance cannot be accidentally left in circuit. Auxiliary carbon and copper contacts and the quick-break action of the switch on opening practically eliminate arcing on the main contacts.

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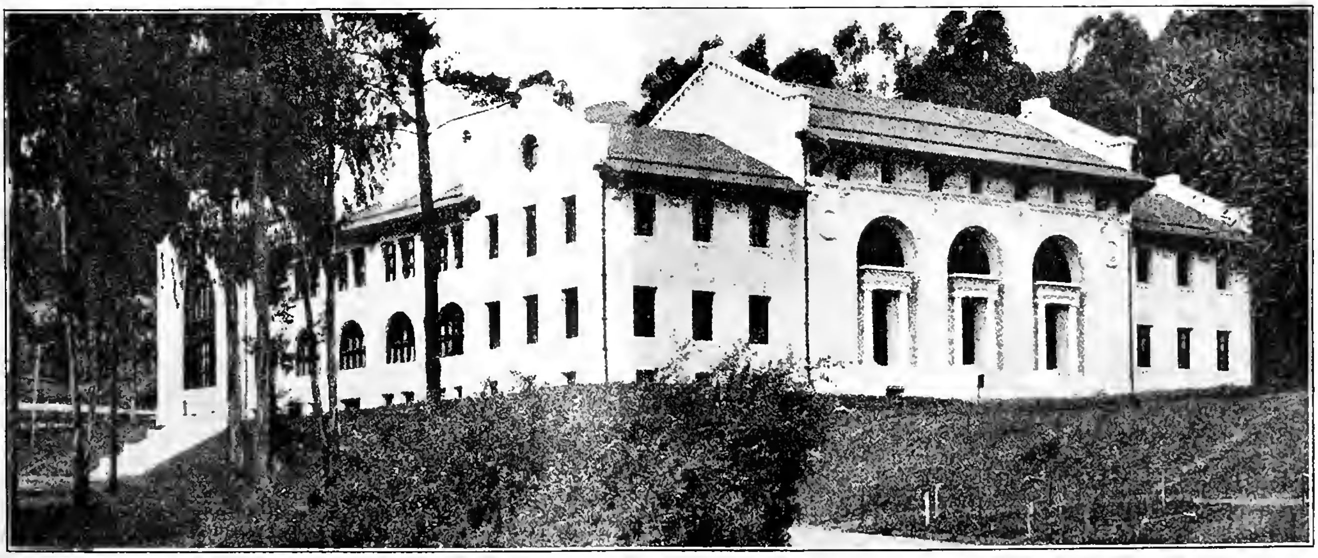
GAS ENGINEERING IN AMERICAN UNIVERSITIES[1]

BY ROBERT SIBLEY.

Introduction.

The rapid rise of California crude petroleum and the high cost of all other kinds of crude gas making materials have made peculiarly favorable the manufacture of oil gas in the Pacific Coast cities. This industry has grown up practically during the past ten years and has given rise to peculiar problems hitherto unencountered in gas manufacture.

As best setting forth some of these peculiar problems, let us review for a minute the titles of some oi the subjects which have been under discussion before this body during the past five years. A glance at the Proceedings of the Pacific Coast Gas Association shows that napthalene troubles have not been infrequent and hence there is embodied much discussion in this organization along this line. "A knowledge of the oil gas situation from a gas man's viewpoint," "The prospects for new production of gas making oil and the determination of water in crude petroleum" having been interestingly discussed before this organization indicate that oil and its uses should play a deep factor in a proposed course in gas engineering. Under the heading of "manufacture of oil gas," papers have appeared on "the history of the gas lighting industry," "the study of water and coal gas," "the progress in oil gas manufacture," "the mechanical handling of the carbon by-product of the oil gas process," "napthalene problems in oil gas manufacture," "the chemical control of oil gas manufacture," "oil gas residual and how to handle it," "carbon in oil gas manufacture," "purification problems"—such problems as these give a strong indication of lectures and investigations to be covered in a specialized study of gas engineering on the Pacific Coast. On the other hand, distribution problems play deep and significant roles in the oil gas industry. The gas meter, napthalene problems in distribution, gas leakage, gas distribution in big cities, high pressure systems of distribution, suburban gas distribution, point out the channels to be investigated after the gas is stored in the holder. Upon delivery to the service pipes of the consumer questions of illumination arise such as effective gas lighting, effects of high pressure upon illuminating gas and a proper method of heat measurement for a maximum illuminating efficiency. Modern methods of heating and the introduction of the gas furnace constitute ever-changing problems and



The Hearst Memorial Mining Building, One of the Beautiful New Structures at the University of California.

[1]A paper delivered before the Twentieth Annual Convention of the Pacific Coast Association at San Diego, Sept. 17, 18 and 19, 1912.

the gas engineer must be ready for their complete solution.

Departing now from the purely technical side, we find that the well-rounded gas engineer should have a comprehensive knowledge of accounting, leading him to sketch out and formulate campaigns for new business getting and efficient methods of gas collections after the delivery of the product has been accomplished.

The rapid rise of corporation regulation has indeed placed an additional burden on the gas engineer and to safely pilot his corporation through the strict rules of regulation he must be familiar with the law, with general methods of appraisal and rate-fixing and he should be ready to define at the proper moment a clear and definite public policy for his corporation; such a public policy would necessitate general knowledge of fire insurance and fire protection as applied to gas and electrical business, a general knowledge of legal matters, especially those relating to damage claims that may arise in the prosecution of the industry. Methods of accident prevention and maintaining proper relations with the public should likewise enter into his training. A well-rounded personality in the young gas engineer should be developed so far as possible, thereby making the engineer capable of dealing with municipal affairs and men. In such affairs technical problems of inspection of gas and gas meters under municipal authorities will arise and troubles with dissatisfied consumers must be met. In fact, as nearly as possible a training in human nature seems to be necessary.

Grouping of Universities.

In casting about for a solution of the problems of the most efficient gas engineering course, I have followed largely the well known proverb of George Westinghouse which states that "It is cheaper to buy experience than to manufacture it." With this idea in mind, then, the latest catalogues of some sixty of the leading American universities have been carefully examined and as nearly as possible all data relating to any phase of gas engineering has been jotted down. Information from a few of our leading American universities is lacking, but it is believed that a careful perusal of the data herewith appended will give a strong conception of the present status of gas engineering in our American institutions. It is believed, too, that the compiled information representing a widely diverse territory will give general conclusions which otherwise might be considered sectional in character. To supplement this general catalogue data I have corresponded with interested representatives of five or six of those universities which seem to have devoted considerable attention to gas power engineering and to the manufacture of gas. Among these universities may be mentioned the University of Michigan, the Massachusetts Institute of Technology, Cornell University and the University of Wisconsin. In compiling the information gotten from these sources I have classified the various institutions into four different groups. No fast and hard lines, however, can be drawn and only in a general way can this grouping be considered applicable. Group 1 constitutes the American universities which seem at the present time to approach nearest that of the proposed course in gas engineering for the Pacific Coast. Group 2 includes all universities of America which seem to give a strongly specialized course in chemical engineering and in gas power engineering or allied subjects in mechanical engineering and heat engineering. Group 3 is made up of those universities and colleges which give either gas power engineering or general commercial engineering without special emphasis on gas manufacture. Under Group 4, I have included those institutions which merely give such courses as thermodynamics and simple applications in gas power engineering and general industrial chemistry.

Group 4.

Under Group 4, as noted in the data appended in the addendum, may be found the following institutions and a brief description of courses pertinent to the subject under discussion:

The Colorado Agricultural College seems to give but one course in thermodynamics covering the study of its general principles and is required in the mechanical engineering course.

Washington University, of St. Louis, Mo., maintains a course in industrial and engineering chemistry together with visits to industrial establishments.

At the Iowa State College a study of heat engines, gas engines and producers and gas engine construction and operation is maintained.

Gas and fuel analyses with a study of boilers and producers is maintained at the Syracuse University.

The University of Arkansas has two courses, one on gas engines and producers and the second on power plant operation and equipment which deals partly with gas and oil engines.

The University of Iowa maintains two courses, one the study of gas and fuel analyses and the other a course in industrial analyses covering the testing of petroleum and coal tar products as well as other commercial products.

The Montana State College maintains but a course in thermodynamics.

The University of Oregon has a course in industrial chemistry and another one in commercial engineering dealing with the systematic study of the appliances used in industrial processes.

The Rose Polytechnic Institute maintains a course in gas engines.

The Lewis Institute covers in its course elementary thermodynamics, heat engines and analyses of engine materials which includes coal and gas fuel value determinations.

Lehigh University has a course in elementary thermodynamics followed by a study of gas engines.

Group 3.

Group 3 as noted above constitutes a seemingly more specialized group of courses in universities looking toward gas manufacture, although even in this group the actual manufacture of gas is but slightly touched upon.

The Rose Polytechnic Institute has four courses, one on gas for oil engines, another on elementary thermodynamics, a third on heat engines and a fourth on gas engine design. The laboratory seems to be well adapted to gas power engineering but very little attention is paid to gas manufacture.

Leland Stanford Jr. University maintains courses in industrial chemistry, heat engines and thermodynamics.

The University of California, although considering broadening the work immensely, maintains at the present time but four courses, two in chemical technology, one in thermodynamics and another in heat engines. These courses are, of course, supplemented in the mechanical laboratory.

Purdue University has two courses entitled Gas Engineering which cover the line of study devoted to the underlying principles of the production and utilization of gas. Gas engine design is also the title of a third course found there.

Ohio State University has six courses, three in industrial chemistry, one in industrial inspection, another on gas engines and producers and still another on the underlying principles of thermodynamics.

Harvard University has three courses entitled Gas Analyses, Industrial Chemistry and Elements of Thermodynamics.

The University of Missouri has four courses entitled Industrial Chemistry, Heat Engines and Gas Producers.

The University of Kansas has likewise four courses entitled Chemical Engineering, Gas Analyses, Gas Engine Design and Elementary Thermodynamics.

Lafayette College discusses the elements of chemical engines and chemical technology in their department of Chemistry and elementary thermodynamics and gas engineering in their Mechanical Engineering Department. The latter course consists of a study of producer gas, water gas and illuminating gas.

The Michigan Agricultural College devotes a term to gas power engineering, being the study of internal combustion engines and power gas generation, which is preceded by a study of elementary thermodynamics.

The Case School of Applied Science takes up the study of elementary thermodynamics following it by a course on gas engines and testing in the engineering laboratory. There is also a course on the testing and analyses of industrial materials.

Group 2.

In this group, as noted above, are to be found a number of splendid courses given at some of our American universities on gas power engineering and chemical engineering. In some of them it may be seen that the manufacture of coal gas is considerably dealt with.

The University of Wisconsin with its laboratory of technical fuel gas and oil analyses, its lectures on municipal gas manufacture and distribution, together with its lectures on power and fuel gas manufacture and distribution is closely allied to the ideal we have in mind for our Pacific Coast course. A deep study into thermodynamics and its practical application in gas engineering is prerequisite to the courses at this university as may be found in more detail in the addendum.

The University of Illinois seems to have strong features leaning toward gas manufacture. Here is found actually a course entitled Gas Engineering and under this are discussed such subjects as, chemistry for engineers, technical gas and fuel analyses, the manufacture of gas, the calorimetry of oils, and the combustion and classification of coal. This work is strongly supplemented from the gas power side in their Mechanical Engineering Department where we find courses in heat engineering, thermodynamics, power measurements, and heat motors.

The Massachusetts Institute of Technology likewise presents a strong course closely allied to the subject under discussion. Here a series of courses on the testing of oils, the analyses of gas, heat engineering and internal combustion engines, indicate strongly the leaning toward this direction.

A course in gas power engineering at Cornell University likewise indicates specialization. Here we find courses on gas machinery design, gas manufacture and distribution, and gas power machinery.

The Armour Institute of Technology with its well equipped laboratories covers thoroughly the subject of gas power engineering, dealing with gas engines, gas power plants, calorific values of fuels and a thorough course of industrial chemistry.

The Sheffield Scientific School of Yale University maintains strong courses apropos to our subject among which may be mentioned power plant chemistry, gas calculations, gas analyses, chemistry for engineers, thermodynamics, gas engineering and advanced thermodynamics.

Finally the University of Nebraska completes this group with seven courses dealing with our subject, four of these are on engineering chemistry, one on thermodynamics, another in fuel testing laboratory, and still another on gas power engineering.

Group 1.

From the information that I have been able to gather, I would include but one American university in Group 1, which is the University of Michigan. Even at this university, however, no specific course leading to a degree in gas engineering has ever been announced although for ten years past in connection with their chemical engineering course considerable attention has been devoted to the subject of gas engineering. In 1901, the Michigan Gas Association endowed a fellowship at this University which allows the occupant, who must be a graduate-student, to pursue an additional year at the University in the study of some problem in gas manufacture. This fellowship amounts to $500 per year. During the past year this same association has established a junior scholarship amounting to $300 a year in addition to the former one. It is interesting to follow the splendid work and splendid impetus that the establishment of this gas engineering fellowship has had in promoting interest and research in gas engineering.

Gas Engineering Fellowship at Michigan.

Let us then devote considerable attention to the fruits of this fellowship at Michigan. The information that I have gotten is by correspondence with Alfred H. White, Professor of Chemical Engineering at the University of Michigan, and who I understand has had the direction of the gas engineering research work. The dominant motive of the founders in establishing this fellowship at Michigan was evidently a desire to enrich the gas engineering profession by bringing into it a few chosen men with special training in the profession with the evident hope that public attention would be called to the desirability of gas

engineering as a career and that thus more men would fit themselves for it. A secondary consideration was undoubtedly that valuable research work might be accomplished.

So significant have the results been of this work in Michigan that during the eleven years not only has the Michigan Gas Association maintained this fellowship, but the scope of the research has been enlarged and advanced until today the U. S. Bureau of Mines is undertaking special investigations in conjunction with the research work at Michigan.

Of the first four holders of this fellowship, three were chemists and one a mechanical engineer. During later years, however, the establishment of a chemical engineering course at Michigan has given such an impetus to gas engineering study that all of the students have come from this course. At the start, since no facilities were offered for gas manufacture, the holders of the scholarship, of necessity, had to devote their time to the study of the utilization of gas. It is interesting and remarkable, however, to see how well this work was performed. Herman Russell, the first holder of the scholarship, undertook the study of the Welsbach Mantle. He showed that with commercial burners and gas of commercial grade the illuminating value of a mantle is closely in proportion to its net heating value and almost independent of its candle power. This would substantiate E. C. Jones of our own Pacific Coast Gas Association in his contention of last year that candle power as the important standard for gas should be relegated to the scrap heap. The next holder of this fellowship, A. F. Traver, continued the investigations of Mr. Russell. This latter investigator was by extremely painstaking measurements able to actually measure the mantle temperature as distinct from the flame temperature and to show that the mantle was, contrary to the theory then usually held, not nearly so hot as the flame. European investigators have since confirmed Traver's experiments. Traver also showed that an increase in the temperature of the mantle meant an increase in light and so called attention to the matter of designing burners which would give high temperature as the logical step toward increasing the efficiency of the mantle. The third investigator took up the subject of the determination of mantles while burning and was able to show that the mantles of some manufacturers suffered less in this respect than others did, and hence pointed out the advisability of testing sample mantles, not only after a few hours' use, but also several hundred hours' continuous burning. At the end of the fourth year, the Michigan Gas Association called attention to the naphthalene troubles that were being experienced among its member companies and Samuel Ball, the fourth holder of the fellowship, devoted his time to necessary initial experiments for the deep investigations to be followed by later holders of the fellowship. He redetermined the vapor pressure of naphthalene and showed that it was not abnormally affected by water vapor, ammonia, acetylene and other substances as had been previously claimed by other writers. He also developed a method for the determination of naphthalene in crude gas and small quantities of tar, which although somewhat inaccurate still holds for the particular purpose, and by application of this method was able to show that tar was a much more important factor in the elimination of naphthalene than had been supposed.

The next holder of the fellowship continued these investigations by studying at various gas works, paying particular attention to the behavior of naphthalene during the condensation of coal gas. He obtained concordant results showing that samples of gas drawn from the foul main, condensers, and tar separators, contained very small amounts of naphthalene in the free state, almost all of the naphthalene being in solution in the tar fog present. Samples simultaneously taken beyond the ammonia scrubbers frequently showed decided amounts of naphthalene in the free state, almost all of the naphthalene being in solution in the tar fog present. These experiments were repeated by this investigator and by his successor and a complete confirmation of the theory advanced the preceding year was established. Thus it was established that the ammonia by its solvent action on the phenols of the tar frequently caused the remaining tar to be saturated with naphthalene. The naphthalene thus liberated was that which later caused troubles in the distributing system.

At the end of the sixth year this work assumed in the eyes of the Michigan Gas Association such importance that it was decided to build an experimental gas plant. As first conceived this was to consist of a miniature retort and condensing system at the University. This conception, however, soon gave way to the larger one of the installation and purifying plant capable of handling the gas from one of the regular works retorts to which it could be connected at will. The installation was planned with the advice of expert gas engineers and with the hearty co-operation of various manufacturers of equipment for gas works. So important now became the results gotten from this experimental gas works that we find in the ninth year the Technological Branch of the U. S. Geological Survey, now the U. S. Bureau of Mines, began undertaking work in conjunction with the investigators at Ann Arbor. In the tenth year the two-room building was enlarged to four rooms and the equipment increased and improved. Thus it is seen what splendid results have been accomplished at Michigan.

Undoubtedly one of the most prominent underlying reasons for the founding of this fellowship is to train men for responsible positions for gas manufacture. Let us for a moment see what these eleven men are doing. Ten have remained in gas engineering work and the eleventh is a consulting engineer. The remarkable prominence obtained by these men is fully set forth in the following professional records:

Herman Russell, B. S., University of Michigan, 1898, M. S., ditto. 1901
- Holder of fellowship in gas engineering.................. 1900-01
- Inspecting engineer Detroit Gas Co...................... 1901-02
- Assistant superintendent Detroit Gas Co.................. 1902-03
- Supt. gas manufacturing, San Francisco Gas & Electric Co... 1903-04
- Assistant engineer Cincinnati Gas & Electric Co........... 1904-05
- Assistant supt. gas manufacturing, Rochester Ry. & Lt. Co... 1905-06
- Superintendent gas manufacturing, Rochester Ry. & Lt. Co.. 1906 to date

Alva F. Traver, B. S. in Mech. Eng., University of Michigan..... 1900
- Holder of fellowship in gas engineering.................. 1901-02
- Draftsman Grand Rapids Gas Light Co..................... 1902
- Assistant superintendent Grand Rapids Gas Light Co....... 1903-05
- Superintendent and engineer Grand Rapids Gas Light Co.... 1905-07
- Engineer Chattanooga Gas Co........................... 1907-09
- Supt. gas dept., Denver Gas & Electric Co................ 1909-11
- Supt. gas and steam heating dept., Denver Gas & Elec. Co.. 1911 to date

Max E. Mueller, A. B., University of Michigan................1903
Holder of fellowship in gas engineering.................1902-03
Clerk Ogden Gas Co., Chicago.........................1903-04
Chemist New Amsterdam Gas Co., New York City.........1905-06
Asst. supt. Astoria Light & Power Co., Astoria, L. I........1906-11
(Mr. Mueller put into successful operation the plant for extraction cyanogen at the Astoria Works and described the process in a paper before the American Gas Institute in 1910.)

Samuel Ball, A. B., University of Michigan..................1903
Holder of fellowship in gas engineering...................1903-04
Student Jackson Gas Co..................................1904-05
Superintendent La Porte Gas Light Co....................1905
Assistant superintendent Saginaw City Gas Co............1905-06
Superintendent Bay City Gas Co.........................1906-10
General superintendent Saginaw & Bay City Gas Co.......1910-11
Manager Bay City Gas, Power & Street Railway Co........1911 to date

David H. Clary, B. S. in Chemical Eng., University of Michigan..1904
Holder of fellowship in gas engineering.................1904-05
Apprentice Jackson Gas Co..............................1905
Chemist Western Gas Construction Co...................1906-07
Gas expert Western Gas Construction Co................1907-09
Superintendent of works, Minneapolis Gas Light Co........1911
Chemist Pittsburgh Coal Co., Minneapolis................1911 to date

Joel M. Barnes, B. S. in Chemical Eng., University of Michigan..1905
Holder of fellowship in gas engineering.................1905-06
Assistant superintendent Saginaw City Gas Co...June to December, 1906
Production engr. Miller & Franklin Co., Boston......Dec. '06 to July '09
Manager Miller & Franklin Co., Boston.
Treasurer Hoophone & Barnes Co., production engineers, Boston ....July '09 to July '10
(Mr. Barnes has been one of the pioneers in production gas engineering. He has devoted himself especially to the textile and paper industries and has introduced scientific methods in about twenty large manufacturing companies in New England.)

Fredrick E. Park, B. S., Chemical Eng., University of Michigan...1906
Holder of fellowship in gas engineering..................1906-07
Assistant chemist Detroit City Gas Co... 1907-08
Chief chemist Detroit City Gas Co.....................1908-10
Superintendent Station B, Detroit City Gas Co............1910 to date
(Mr. Park developed a method of identifying gas oils by measuring sp. absorption of bromine, which was described in a paper read before the American Gas Institute in 1909.)

John H. Wyman, B. S. in Chem. Eng., University of Michigan....1907
Holder of fellowship in gas engineering..................1907-08
Assistant superintendent Ann Arbor Gas Co..............1908-10
Assistaut superintendent Kankakee Gas Co...............1910-11
Chemist Grand Rapids Gas Co.........................1911 to date

William A. Dunkley, B. S. in Chem. Eng., Univ. of Michigan....1908
Holder of fellowship in gas engineering..................1908-09
Cadet engineer Lansing Fuel & Gas Co...................1909-10
Chemist C. H. Geist Co., plant headquarters, Atlantic City, N. J. ....1910 to date

Benjamin M. Ferguson, B. S. in Chem. Eng., Purdue University..1909
Holder of fellowship in gas engineering..................1909-10
Asst. chemist and time study man Detroit City Gas Co.....1910 to date
(Mr. Ferguson has recently been devoting most of his time to studies in scientific management. He contributed a paper on this subject at the 1911 meeting of the Mechanical Gas Association.)

Reuben S. Tour, B. S. in Chem. Eng., University of Michigan.....1910
Holder of fellowship in gas engineering..................1910-11
Asst. to supt. Consolidated Gas Co., 21st St. Sta., N. Y.....1911 to date

Rudiments in a Gas Engineering Course.

From the general outline of work entering the field of gas engineering given at the outset in this paper, it is clearly evident that the young engineer to successfully grapple with them should be prepared to solve all those problems which arise in general engineering practice. At the completion of this general engineering course, he should have a working familiarity with organic chemistry, with a special emphasis on coals and crude petroleums. The by-products of coal manufacture with coal tar, ammonia and their handling should be emphasized, and also the investigation of the breaking up of crude petroleum under constant temperatures with special reference to the electric furnace for the treatment of oils under constant temperatures. On the other hand, the mechanical engineering features are strongly requisite for the well-rounded gas engineer. In particular may be mentioned blacksmithing and machine pattern making, together with finished foundry work, strength of materials with emphasis on building design, especially in structural concrete work and brick work. The study of combustion and the losses in distribution in the use of all kinds of gas should be mastered. Mechanical drawing with a knowledge of building design and how to talk with a lead pencil, involving free hand sketching of mechanical objects and piping are also imperative.

Bearing, then, these characteristics in mind, it would seem that the ordinary four-year college course is too little time to give to such a specialized training. The four-year course at the University of California is organized not only to teach the fundamental principles that underly general engineering but also to give practical training and such construction in the economics of engineering as is possible in a technical school. The success of an engineer has come to mean his ability to meet engineers and men of culture on equal terms and since the work in the regular four-year course is almost wholly technical, a fifth year is imperative to gain the finishing work necessary in general culture subjects as well as deep investigation in the specialized matter pertaining to the work under discussion.

A Suggestion for Students of Mechanical Engineering.

At the University of California, the following courses are now given in Mechanical and Electrical Engineering. There is also included a suggestion for a possible combination with the Chemistry Department for such courses as may best prepare students in the department of Mechanical Engineering for a later specialization in Gas Engineering.

COLLEGE OF MECHANICS—FOUR-YEAR COURSES.

Matriculation Requirement, Group II.

I.

	Units.	
Subject A	.	.
Math. 3A-3B	3	3
Phys. 1A-1B	3	3
Chem. 1A-1B	3	3
Chem. 3A-3B	2	2
C. E. 1A-1B-1C-1D	3	3
Phys. Cult. 1A-1B	1	1
Hygiene 1	2	.
Mil. 1A-1B	½	1
Mil. 2A	1	.
C. E. 3A (Sum)	(3)	
Elective	.	1
	18½	17

II.

	Units.	
Math. 4A-4B	3	3
Phys. 2C-2D	3	3
Draw. 2A-2B	3	3
Mech. 1A-1B	3	3
Mech. Eng. SA	2	.
Mech. Eng. 106A	.	3
Mil. 1A-1B	½	1
Mil. 2B	1	.
Mechanical		
Mech. Eng. 8B	.	2
Elective	3	.
	18½	18
Electrical		
Mech. Eng. 8B	.	2
Elective	3	.
	18½	18
Gas Engineering		
Chem. 5A-119	3	2
	18½	18

III.

	Units.	
Mech. 102A-102B	3	3
or		
Phys. 105A-105B	3	3
C. E. 8A-8B	3	2
Mech. Eng. 106B	2	.
Draw. 105	.	2
Elec. Eng. 110A-110B-110C	2	3
Mechanical		
Mech. Eng. 9A-9B	2	2
Math. 110A-110B	2	2
Elective	4	4
	18	18
Electrical		
Math. 110A-110B	2	2
Phys. 107A-107B	3	3
Mech. Eng. 9A-9B	2	2
Elective	1	1
	18	18
Gas Engineering		
Mech. Eng. 9A-9B	2	2
Chem. 8A-8B	2	2
Chem. 8C	.	2
Elective	4	2
	18	18

IV.

	Units.	
Mech. Eng. 104A-104B-104C-104D	3	3
Mech. Eng. 103A-103B	3	3
Mech. Eng. 105A-105B	3	3
Mechanical		
Draw. 107A-107B	2	2
Mech. Eng. 107A-107B-107C-107D	2	2
Elective	3	3
Thesis	2	2
	18	18
Electrical		
Elec. Eng. 111A-111B	4	4
Elec. Eng. 111C-111D	3	3
Thesis	2	2
	18	18
Gas Engineering		
Mech. Eng. 107C-107D	2	2
*Mech. Eng. X	.	3
**Chemistry X	3	.
***Chemistry X_1	3	.
****Mech. Eng. 107E	1	1
Thesis	2	2
	17	17

NOTE:

*Mech. Eng. X—Gas Plant Construction.

**Chemistry X—Chemistry of Gas Manufacture.

***Chemistry X_1—Physical Chemistry.

****Mech. Eng. 107E—Gas Engineering Laboratory (one afternoon per week—new).

It is seen from the above (and we may note in passing that this course is practically the same in the first two years in all the Engineering Colleges at Berkeley) that certain electives are open at the beginning of the sophomore and throughout the junior years. It will be well, then, to fill in these electives by rounding out a knowledge of chemistry. This should consist in thorough courses in quantitative analyses and in organic chemistry.

Complete Outline of Gas Engineering Course.

Taking now into consideration the present status of gas engineering in the American universities—particularly the excellent results of eleven years of experience as brought out in Michigan—and adapting all these ideas to Western conditions and problems, it would seem that the following outline would bring about the best results in preparation for an active life in gas engineering. A student upon entering college should take such a course during his freshman year as would give him a thorough grounding in the elements of mathematical analysis, a comprehensive study of fundamental physics, elementary inorganic chemistry through qualitative analysis and the elements of plain surveying with sufficient ground work to give him an elementary idea of the laying out of distributing mains and the necessary plotting of typographical features encountered. The sophomore year should continue the grounding in mathematical analysis begun in the freshman year and carry the student through differential and integral calculus. Higher physics should be undertaken in order to clinch the ideas begun in the freshman year and, in addition, mechanical drawing, followed by descriptive geometry, should be undertaken in order that the student may learn to talk with the lead pencil when future call may come upon him in the design of gas engineering plants. Shop work, dealing with pattern-making, should also be undertaken. In addition to the foregoing work of the sophomore year, quantitative analysis should also be studied in the Department of Chemistry. In the junior year, having now laid the fundamental basis for technical study, the mathematics of physics, or what is known as engineering mechanics, with its splendid training in mental development should be taken. The shop work begun in the sophomore year should now be supplemented with foundry work and machine shop practice, in order that the many intricate problems met with in power plant design may be practically solved, should future occasion present itself. Indeed a thorough course in machine design should supplement the work in the shop as should a thorough grounding in the study of strength of materials and structural design. Organic chemistry should also be undertaken during this period in order that now, having completed the junior year, the student may get his first insight into real practical gas engineering. At the completion of this year arrangements should be made for those having this thorough ground work to pursue a summer's work in the gas plant of some of the member companies of this association. In this work the student should start, if necessary, at shoveling lamp black and in fact get as near to the actual process of gas manufacture as may be possible. This three months' grounding will give him a thorough idea of the gas industry and unquestionably the beginning of the senior year will find him more serious and sober than ever before in his mental attitude toward his future profession. Having then successfully passed through the summer's work, the senior year at the University should consist of a thorough grounding in thermodynamics, a study of heat engines and gas engines, a study in elementary gas manufacture and perhaps a thorough course in hydraulics or the flow of liquids in order that future problems in the flow of gases may from analogy be the easier solved. A thesis during this year should be carefully chosen in order that he may try out by experiment some of the problems which unquestionably will suggest themselves to him during his summer's work at the gas plant, undertaken as noted above at the completion of his junior year. Having now obtained his degree (Bachelor of Science) the engineer in embryo should enter again some of the plants of the Pacific Coast Gas Association. This time, however, he should be placed for a summer's work in the laboratory and other instructive branches of the gas manufacturing industry, so that when the opening of college arrives in the fall, no doubt longer should remain as to the significance and opportunity of the life work he has before him. Upon his return to college in the fall, he should devote the year to subjects of general culture and to some specialized investigation along his chosen field.

As to the subject matter to be undertaken in this specialized investigation and as to the equipment required, we may now draw forceful conclusions from the experience of the last eleven years at Michigan above enumerated. It has been seen that in American Universities at the present writing there is little attention paid to specialized coal and water gas manufacture and none whatever to the varying and intricate problems encountered in oil gas production. Indeed, the rapid rise in gas distribution over long distances already presents many problems which hitherto have been solved by rule of the thumb only, but which in the future, due to research of this sort, may be put upon a more rational basis. The experience at Michigan points indelibly to the conclusion that an experimental gas plant is absolutely necessary and that this preferably should be located at a nearby commercial installation. The most striking conclusion presented, however, is that the most lasting and interlinking co-operation between the university offering this course and the gas association contributing thereto is absolutely imperative. From the fruitful results obtained at Michigan it is seen that the training of competent and successful men to enter the profession follows at once in the footsteps of a gas engineering course. Indeed, not only is the association blessed with having highly trained specialists enter the industry but the successful solving of intricate and complicated problems in gas manufacture and distribution is the inevitable result. It would seem, then, that rather than the endowment of a fellowship as has been undertaken at Michigan, it would be better that the money offered by this association go toward equipment or toward the employment of a research instructor to be ever on the alert to point out the path for these research students returning in

their graduate year, rather than waste ammunition in offering fellowships, for a sufficient number will enter the work without encouragement of this sort.

Possible Saturation of Field.

During the past year the University has placed three of its graduates from the Mechanical Engineering Department with the gas department of the Pacific Gas & Electric Company. These young men are today busily engaged in acquiring the rudiments of the art. By the placing of these three men experience has already shown that too soon may the field of gas engineering become saturated unless hearty and wholesome co-operation is extended from every member company of this gas association. The rapid rise of unforseen uses of gas and, also, the increasing importance of the internal combustion engine make the future of gas power engineering exceedingly bright. Hence in view of a possibility of an over-saturation of gas engineers in the manufacture of gas we must not lose sight of the fact that the proposed courses in gas engineering should equally prepare the student to enter the wide and promising field of gas power engineering. Thus will be given pliability and elasticity to the opportunities offered in all phases of gas engineering.

The Question of a Degree.

The question of a degree to be conferred, if at all, is one of many complications. At the present time no university in America confers the degree known as "gas engineer." At the University of California no professional engineering degree is given the student upon graduation from the engineering college, the degree awarded being simply B. S. or Bachelor of Science. Unquestionably the student returning for his fifth year as outlined above should upon its successful completion be awarded the degree of Master of Science in accordance with the regulations now in force at the University. As to whether a further degree should be conferred upon the student after years of practical research and experience, it is difficult to say whether even then the better part of wisdom would indicate that this be done. After all the Biblical quotation "By their fruits shall ye judge them" is the most potent mark in life by which the engineer may be known.

In all of the discussion set forth above it is to be understood that the ideas expressed are only individual and in no sense are to be considered the sentiment of the University Academic Senate or a leaning of sentiment by the Faculty but rather have they been expressed to bring out a thorough and complete discussion here of the different points mentioned.

Environment.

As a final consideration of a gas engineering course or courses, often even more important than considerations of technical and cultural subjects and even research equipment, is that of environment surrounding the student during his undergraduate days. What nobler mission could a university of the West have than that of fitting men for the solution of western, yes, world-wide, problems in gas engineering and how well is she prepared by her environment to fulfill this mission! With her beautiful hills to the east, the Golden Gate to the west, California inspires her sons to go ever onward and upward in the realms of scientific thought and research. Between snowy peaks to the north and burning deserts to the south she has distributed with lavish hands opportunities which it is for her sons to develop. The welfare of the state calls for the welfare of her university and that we should ever seek the welfare of our university is the most lasting lesson that she teaches those of us who have the honor and privilege of calling her our Alma Mater.

Independence in Research.

In the present day development of California two types of men are present, those who have made their all and have come West to live with us in an ideal atmosphere and those of the ambitious, but poor, whose motto is to strive and to work.

The noble motive promoting the gigantic effort shown in the collecting of a substantial fund among the member companies of this association is indeed to be commended in the highest terms. By means of it this insignia "to strive and to work" will be placed one step higher. This association, already emblazoned in the hearts of men, and known by its own motto throughout the length and breadth of our coast cities as ever active and alive—indeed as having no "dead ends," may well be said to be materially aiding in bringing about that time of unhampered individuality in study and research of which Kipling has so forcefully written:

"And only the Master shall praise us,
 And only the Master shall blame,
And no one shall work for money,
 And no one shall work for fame;
But each for the joy of the working,
 And each in his separate star
Shall paint the things as he sees it
 For the God of the things as they are."

STATUS OF AGITATION AGAINST CALIFORNIA LAW NO. 499.

Referring to State Law No. 499 it seems to be the opinion of most of the representatives of the power companies that for the present it is better to leave State Law No. 499 alone, and wait until the Railroad Commission has issued General Order No 26, as all believe the best way to handle the situation is to try and get State Law No. 499 repealed at the next meeting of the State Legislature, and have the entire supervision of this work come under the State Railroad Commission, where the work can be handled by the Commission engineers in a practical manner, and the power companies can then at any time appear before them and get rulings on any disputed point which may come up.

COLLEGE COURSES IN LOGGING METHODS.

At the Pacific Loggers' Congress recently held at Tacoma resolutions were passed to petition the State universities of California, Oregon, Washington, Idaho, Montana and British Columbia to provide courses in logging engineering. Committees have been appointed and an active campaign is to be conducted to this end. Geo. M. Cornwall, of the Timberman, at Portland, has originated this movement to provide special technical and scientific training for young men entering the lumbering industry. One of the most important subjects proposed is that of the application of electricity to lumbering.

PRESIDENT'S ADDRESS, PACIFIC GOAST GAS ASSOCIATION.

BY WM. BAURHYTE.

As president of the Pacific Coast Gas Association it is my pleasure to welcome you to our twentieth annual convention. We meet this morning in the extreme southern end of the territory covered by our Association, and for the first time in this beautiful city of San Diego, with its arms stretched out to give first welcome to the mighty ships of commerce that are soon to come from the Atlantic through the great canal to our beloved shore. Whether this be your first visit or not I am sure you cannot but marvel at the progress of this city and the rapidity with which it is coming into the front ranks of the great cities of the Pacific Coast.

The remarkable increase in growth of these great centers of population carries with it the concomitant duty of the gas industry to expand in even a greater ratio in order to not only meet but to anticipate the needs of the community. You gentlemen know how well this demand upon our resources has been met. Not only has the past year in the gas industry been marked by a continuance of the great activities of the preceding years, but by an ever increasing ratio of activity in construction, as well as in developing the most modern methods of manufacture.

Nor has this Association failed to benefit by such growth. Its increase in membership is very gratifying, and I desire to particularly welcome those to whom this is their first attendance in convention. Even more noticeable perhaps than the increase in membership has been the increase in the number of excellent papers tendered your officers, and which for lack of time, they have been unable to accept. To encourage this activity rather than stifle it by our inability of proper recognition, it seems to me that at this time an amendment to the by-laws should be suggested extending the period of meeting so as to allow three full days for the business of the Association and the discussion of the papers presented. Since, however, at this convention we are limited to two days, you are requested to be prompt in attendance and to confine your remarks to the point in order to conserve time and enable the members to derive the maximum benefit.

Mr. Frank W. Leach, Jr., my predecessor in office, in his address at the nineteenth annual convention, referred to Constitutional Amendment No. One, quoting the Act for your benefit. This Act has now been in operation for two years, and has vindicated the claims of the Commission that drew it that it would simplify as well as unify taxation governing utility companies. While some difficulty was experienced at first with local assessors on the question of operative and non-operative properties, necessitating hearings before the State Board of Equalization, this friction in the operation of the new law has been negligible as compared with the experience under the old method, involving as it did long drawn contests before local Boards of Equalization, as well as actions at law in an almost vain effort to secure the same method of assessment for the property of utility companies as was applied to that of individuals.

At one of the meetings of our last session we were honored with the presence of Doctor Benjamin Ide Wheeler, President of the University of California, who discoursed at length upon the benefits to be derived from the establishment of a course of study at that institution leading to the degree of "Gas Engineer." Quite a large sum was subscribed toward the establishment of such chair, the very urgent need of which has been graphically told by our esteemed secretary, Mr. John A. Britton. I might add, however, that during the past two decades our great universities have been vieing with each other in turning out electrical engineers, but few, if any, have devoted any attention to gas engineering beyond that involved in the chemical laboratory. It is hoped that the great opportunity thus presented to us will not be lost through lack of funds.

The matter of holding a gas congress in San Francisco in 1915 was first considered at our convention in 1910, and again at the annual convention in Oakland in 1911, at which latter meeting a committee was appointed with full power to actively take up the matter. In a recent letter to our secretary from the secretary of the American Gas Institute, Mr. Ramsdell states that the Institute is probably in the most favorable position to bring about the ultimate success of such a congress, since the bulk of the associations are in the eastern half of the country, but before proceeding with the matter they desire an expression from our Association as to the feasibility of the plan, since, as he states, the Pacific Coast Gas Association would necessarily have to enter into the arrangement to a considerable extent to insure its success. I trust therefore that you will give earnest attention to the report of that committee to be presented at this meeting, as it will express their views regarding the steps necessary to make this the greatest gathering of gas men ever held.

For your further information I quote from the American Gas Institute News for July, 1912, as follows:

> One of the most important events in the gas history of this country was the Gas Congress held in connection with the Louisiana Purchase International Exposition, June 15 and 16, 1904, at St. Louis, Mo., in which ten gas associations took part.
>
> Although the preparation for the meeting was rather hurried and therefore not as carefully planned as further time would have allowed, yet the results fully demonstrated the value and importance of such a gathering. The unique character of the meeting permitted the associations to see the greater and broader field that could be filled by combined numbers and work, in a clearer way than ever before.
>
> As the tendency in the Gas Association field at the present time is in this direction and as some national event seems necessary to awaken proper interest, would it not be well to begin at once to consider the advisability of holding another congress to embrace all the gas associations, during the Panama-Pacific International Exposition to be held in San Francisco in 1915?
>
> If our membership consider it wise to undertake to accomplish this, steps should be taken promptly to enlist the co-operation of other associations and the arrangement of details to make the movement one of national interest and importance.

Governmental control of public utilities has become an established fact in California. It is unfortunate, however, that the Act vesting the railroad commission with control over public utilities still

permits municipal regulation under certain conditions. Under state control, such as exists in New York, Massachusetts and Wisconsin, better results are obtainable than is possible with local boards, the membership of which very largely represents and is subservient to the dominant public opinion. In many instances such control is vested in those whose very political fortunes are due to agitation against public utilities, and who become partisans of the consumer in rate regulation to the disregard of the equities of the companies involved, thus entirely losing sight of the moral responsibility of their trust, a responsibility comparable to that of a judge. State commissioners, well paid and of long tenure of office, are much farther removed from local prejudices and influences. Their rulings, being printed, become precedents for their own future guidance as well as that of similar bodies in other jurisdictions, as are the decisions of courts of law. The dignity of their position and the realization that their rulings are monuments of national importance for or against their erudition and sense of justice induces the members to give their best thought and judgment to each problem presented. Such a commission more nearly approaches what it should be—a bulwark for the consumer against oppression and extortion and a guarantor to capital of the inviolability of property rights. It is to be hoped that before long a commission with such absolute control throughout this state will be established.

At the meeting held in Los Angeles in 1910 it was stated that natural gas in large quantities had been discovered in the Kern County oil fields. Since that time active work has been going on to render the supply in the fields available, and towards the construction of pipe lines of sufficient capacity to transport the gas to the cities of Southern California for distribution to domestic consumers. The supply is believed by those engaged in this work to be sufficient to last for many years, but it is hoped that this belief will be tempered by the experience with natural gas in other localities, particularly in the state of Indiana, and that the use of this gas will be governed by conservation rather than waste.

One year is a very short time in which to notice any great progress in a single field of activity. In the gas industry the progress during the past year has been along steady and useful lines. It is impracticable for me, however, to enumerate the specific improvements. For these I must refer you to the columns of the various technical journals.

The Experience and Wrinkle Editors have been very industrious, and will present for your consideration matters that will prove of the greatest benefit.

Our particular thanks are due to the Novelty Editor, Mr. R. L. Clarke, of San Diego, for his assistance and co-operation along these lines. I also wish to thank the officers and members of the Association for their cordial co-operation during the year, and also to thank the San Diego Consolidated Gas & Electric Company, through its general manager, Mr. H. H. Jones, who will be our host at the outing next Thursday, for the many courtesies extended while the details of this convention were being arranged.

WELDING OF HIGH PRESSURE PIPE LINES.

BY LEON B. JONES.

Since the transmission of gas under high pressure has come into common use, many have been the dreams of the members of the gas fraternity of a faultless coupling.

Improvements in the manufacture of pipe, and the development of the seamless drawn steel tubing, leave little to be asked in the way of pipe, but, as a chain is no stronger than its weakest link, so is a pipe line no stronger than its weakest joint.

Heretofore, the couplings or joints have been the short lived part of high pressure pipe lines. In practically all the couplings now in use, a compressible elastic gasket is necessary. Rubber has been used in joints of most of the pipe lines in California, but as the short time in which rubber loses its elasticity is greatly decreased by the rotting effect of the compression liquids of the gas, the life of rubber gasket joints is very much less than the life of the pipe.

Pipe lines have been abandoned or removed, because the elasticity of the rubber in the joints was gone, and every coupling was a leak, and still the pipe, if undisturbed, would have had a considerable life. In some cases, the gaskets were removed after several years, and the pipe was still in good condition. Up to the present time, the life of high pressure pipe lines laid in the average soil, has been the life of the joint.

With the recent developments in oxy-acetylene welding, a new era has been reached in the transmission of gas under high pressure. It is now possible to lay a pipe line without couplings of any sort. A steel-to-steel tube in which the joining of the lengths is of the same material as the pipe.

Welding with the oxy-acetylene torch has been successfully done in the large shops for several years, but the recent installation of an 8 in. high pressure line in San Francisco is unique in the adoption of this process to the welding of high pressure gas mains.

The oxy-acetylene torch develops a flame temperature which may conservatively be estimated at 6000 degrees Fahrenheit, and it may readily be seen that with this temperature concentrated in a small pencil flame, under perfect control, that all the metals become amenable to the will of the operator.

The welding of iron, steel, copper or brass is accomplished with greater ease and rapidity than the soldering of tin. When this powerful little flame impinges on steel, the metal becoms molten in a few seconds.

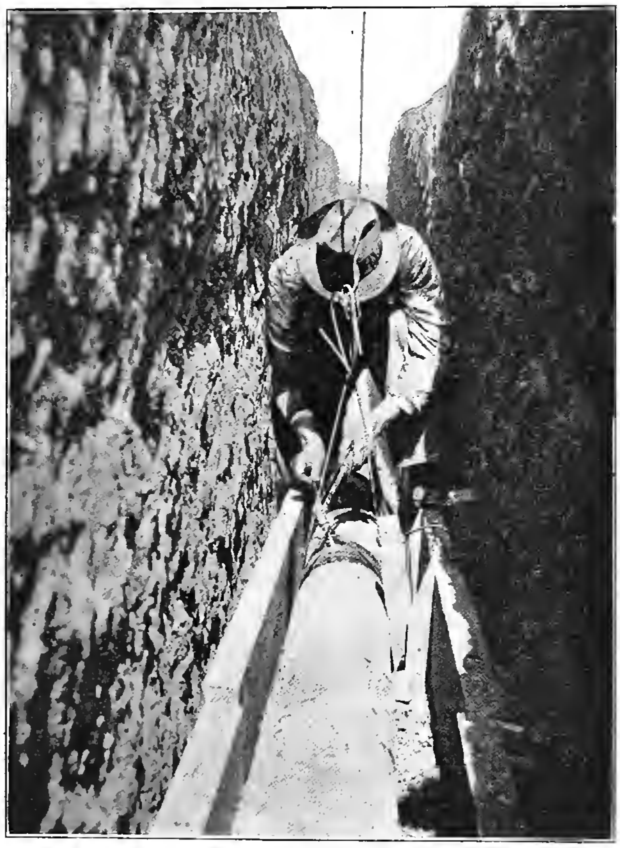
The recent installation of approximately 5000 feet of 8 in. steel tubing in San Francisco, in which the oxy-acetylene welding was used on every joint, was laid under the most difficult conditions, and afforded an excellent opportunity for practically testing the adaptability of welding, to high pressure gas mains. This line was laid in Geary street at the same time the municipal railroad was under construction, and this, necessarily, caused many obstructions and difficulties, but in every case, the oxy-acetylene welding proved itself equal to the occasion, and all difficulties were surmounted.

There are three separate methods in which pipe

may be handled when welding with the oxy-acetylene torch.

Bell holes may be dug as for any coupling, and the pipe welded in the ditch, or the pipe may be lowered into the ditch and turned while the welds are being made, thus the welding of many of the joints is done on the top of the pipe, and the necessity for digging large bell holes at every joint is avoided.

The third method, which was found to be the most practicable, where conditions will allow, is to put short pieces of timber across the top of the ditch at intervals and roll the pipe into places directly over the ditch. This method insures a good align-

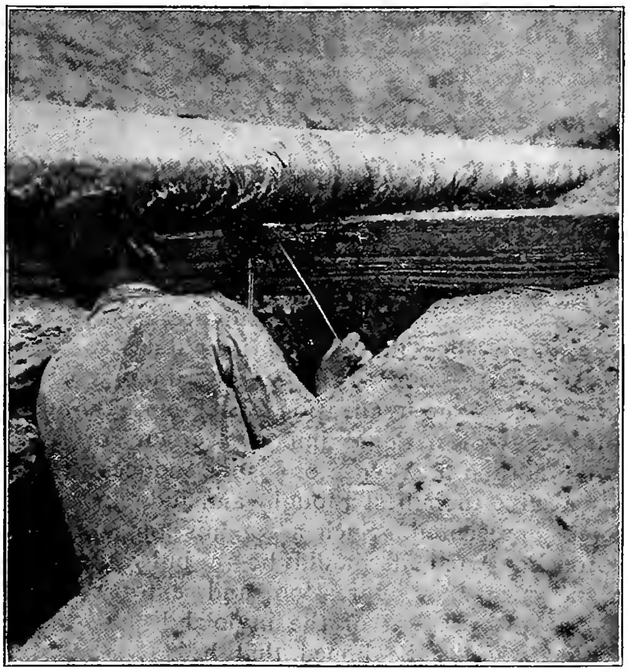


Welding on Top—Pipe Turned in Ditch.

ment of the joint, and requires the least labor. With this method, two men can turn as much as 500 feet of pipe, while the operator is welding the joints, and as 500 feet is about as long as can be conveniently handled, it will thus only require a bell hole and a weld in the ditch every 500 feet.

While it is possible to make a good weld without turning the pipe, a great deal more time and care are necessary than when the pipe is turned, and the welding is always done on the top of the joint. In welding the under side of a joint in the ditch it is not possible to pile up the metal, as when welding is done on top of the joint. A joint being welded in the ditch is also more often allowed to cool before the weld is completed, and this leaves a possibility of pin holes where the weld is commenced again.

To insure against the possibility of the weld not extending through the entire thickness of the pipe, the ends of the lengths to be welded were left about ⅛ in. apart, and the operator worked with a rod of 3/16 in. Norway iron in his left hand. This iron is melted into the joint to take care of the gap, and also to build up the metal around the joint. In this way the ends of the pipe are perfectly welded, and the metal at the joint is thicker than in the pipe, thus making the joint the strongest part of the line.

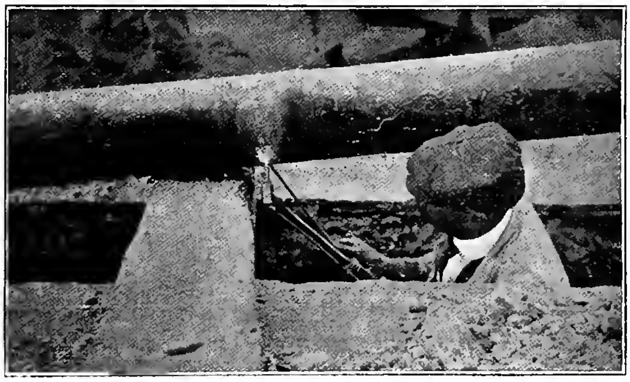


Pipe Being Fed Into Ditch as Each Length Is Welded.

To prove this statement that the weld is as strong, if not stronger, than the rest of the pipe, sample welds were made, and the pipe was afterwards flattened and bent until it was broken. In every case the break occurred back of the weld in the pipe and not across the joint.

A more practical test, which will appeal to gas men, was also made as follows:

Two 40 ft. lengths were supported on timbers laid across the ditch, and the ends welded together All the supports were then removed from under one



Welding Underneath Pipe.

of the lengths, and the entire weight of this 40 ft. length was suspended on the joint. The weld was in no way affected by this severe treatment.

After several hundred feet of pipe are welded into a section, the supports are removed one at a time, and the pipe reeled into the ditch like so much cable. Careful handling is no longer necessary as a weld, if properly made, will stand the same treatment

as the pipe, and any defect is better detected before the pipe is covered.

It may be readily seen that when welding the pipe on top of the ditch, into sections several hundred feet long it is possible to work several welding outfits at the same time, with the minimum of labor. If a little care is exercised in distributing the pipe along the ditch, two men can readily roll it into place, over the ditch, for welding. In many cases, after these sections were reeled into the ditch, the ends of the sections were several feet apart. To avoid using a short piece of pipe and making two welds, a block and tackle was used, and with an automobile for a motive power, these sections, in some cases, 500 feet long, were dragged several feet in the ditch to meet the end of the next section.

As the tubing which was used on this line was approximately 3/16 of an inch thick, and would not permit of threading, the question arose as to how valves or governors should be connected. This was solved in a very simple manner. A short piece of 8 in. standard pipe was threaded onto a standard flange. The standard pipe, which was 8 in. inside diameter, was then slipped over the tubing which was 8 in. outside diameter. After the valve or governor was installed, and the flanges bolted up, the end of the standard pipe was welded to the tubing.

This installation, which represented about 180 joints, was welded throughout its entire length. At the end of each day's work, the line was tested to 150 pounds pressure, and allowed to stand over night. As an extra precaution the joints were also gone over with soapsuds. After completion the entire line was tested to 150 pounds pressure. The line stood at this pressure for three days without loss.

The success of oxy-acetylene welding in the field of high pressure gas distribution depends largely upon the cost of operation, and its ability to meet the general conditions existing in high pressure work. Such an apparatus to meet the requirements of the present day gasman must be economical, reliable and safe.

Cheap electricity has made possible the use of the electric furnace for commercial products and calcium carbide of excellent quality is now obtainable at a very reasonable price.

There are two general methods in which calcium carbide and water may be brought together for the purpose of generating acetylene gas. "Water to Carbide," or "Carbide to Water." Generators may, therefore, be classed as water feed or carbide feed, In the early stages of the development of acetylene, most of the generators were of the water to carbide, oı water feed type. This was due to the fact that it was far easier to regulate the flow of liquids than of solids.

However, practice has proven the carbide feed type to be the safest and also to produce the purest acetylene. In this type the carbide is fed into an excess of water, and therefore, the temperature of the generators cannot exceed the boiling point of water and the acetylene, in bubbling up through the lime water formed in the generator, is freed from most of its impurities.

The heat produced from one pound of calcium carbide and the slacking of the calcium oxide formed, is sufficient to raise four pounds of water from the freezing point to the boiling point. It is, therefore, essential that the water in an acetylene generator shall always be in excess.

If a few general precautions are taken there need be no danger in the production of acetylene.

But the compression of acetylene is another story. One of the dreams of the early acetylene industry was that this gas might be safely compressed into a liquid form for convenient transportation and storage. This would appear to be an ideal condition as acetylene liquefies at the comparatively low pressure of 700 pounds per square inch, and a cubic foot of liquid acetylene represents 400 cubic feet of gas. This liquid is only four-tenths as heavy as water.

It must be remembered that acetylene gas is an endothermic compound. In its formation heat is absorbed and that spontaneous decomposition will take place liberating this heat if subjected to abnormal temperature or pressure.

Many violent explosions have occurred due to liquefied acetylene, and now acetylene compressed in open containers to a pressure exceeding two atmospheres (3 lb.) is considered a very dangerous material.

However, calcium carbide represents a more condensed form of acetylene for transportation than the liquefied gas. A cubic foot of carbide represents about 500 cubic feet of available gas, while a cubic foot of liquefied acetylene represents only 400 cubic feet of gas.

Recent developments have also provided a substitute for liquid acetylene in what is known as dissolved acetylene.

While acetylene is soluble in its own volume of water, its very great solubility in acetone has broadened the field of the uses of acetylene many fold. Acetone will dissolve 24 times its volume of acetylene at atmospheric pressure, and for each additional atmosphere to which it is subjected, a similar quantity will be dissolved, in other words, the solubility increases directly with the increase in pressure.

Dissolved acetylene makes possible hundreds of uses of acetylene and the oxy-acetylene blow pipe, which would have been impossible before its discovery.

With the use of dissolved acetylene and oxygen under pressure, a complete oxy-acetylene welding outfit is very readily portable and ready for instant use and can be used in many places where a generator would be impracticable or impossible. When acetylene is dissolved in acetone it seems to be devoid of all possibility of an endothermic explosion under pressure. But the bulk of acetone is greatly expanded by this great absorption of acetylene and it will readily be seen that any container used for acetone for the dissolving of acetylene must be in capacity equal to the acetone expanded.

As the acetylene was used from such a container and the acetone contracted to its normal bulk, open spaces would be left above the liquid in which free or undissolved acetylene would exist, and thus create

danger from explosion. This is overcome by the use of a porous solid which is inert to the acetone and also to the acetylene.

Asbestos is adaptable for this purpose and as it is from 75 per cent to 80 per cent porous the tanks can be packed to exclude all possibility of open spaces for free or undissolved acetylene, and yet leave the greater part of its capacity for acetone and dissolved acetylene.

Calcium carbide can now be obtained at five cents per pound, and as a pound of carbide will produce five cubic feet of acetylene, the cost of acetylene will be one cent per cubic foot at the generator. With an additional cost for compression if it is desired to use dissolved acetylene from tanks under pressure.

Until the introduction of the autogenous or oxy-acetylene welding practically all of the oxygen used in the United States was used for medical purposes and consequently exorbitant prices were obtainable. But since the entrance of oxygen into the commercial field many fertile minds have been busy with the problem of its economical production. Probably the most widely known method is from the reaction of certain chemicals. Oxygen is easily obtained by heating chlorate of potash or chlorate of soda, but as the reactions take place violently with the resultant release of all the oxygen at once, the reaction is impeded by the addition of one-quarter part of black dioxide of manganese. With the addition of the manganese dioxide, the oxygen is given off continuously until the reaction is complete.

Another method is the use of chloride of lime and copper sulphate with the addition of iron sulphate as a catalyzer.

But as the use of chemicals for the production of oxygen is not feasible on a large scale and the economy limited by the price of the chemicals, other methods must be resorted to.

Oxygen may be very cheaply produced by the liquefication and distillation of air. The air is liquefied by high pressure and low temperature and the oxygen and nitrogen separated by distillation due to their difference in boiling points. This is probably the most economical method of producing oxygen as there is an unlimited market for the residual nitrogen as a fertilizer. This method requires an extensive and expensive outlay for equipment and the market for oxygen has not, as yet, warranted the installation of such a plant in the United States, although oxygen has been produced in large quantities in this way in Europe for several years.

Another method which is probably the most promising of cheap oxygen in the near future is the electrolysis of water or the dissociation of water by the use of electricity. The cost of production of electrolytic oxygen is directly dependent upon the cost of electric energy. The cost of equipment for this method of production is not prohibitive and with the prevailing low prices of electricity, oxygen should be obtainable in the near future at a cost not to exceed two and one-half cents per cubic foot.

Acetylene gas of all the hydro-carbon gases most nearly approaches pure carbon. It is over 92 per cent carbon and has a heating value of 1685 B.t.u. per cu. ft. and this partly explains the remarkable temperature attained with the oxy-acetylene blow pipe.

Acetylene requires for complete combustion 12½ times its volume of air or 2½ times its volume of pure oxygen. If complete combustion were attained by burning acetylene with 2½ times its volume of oxygen the products of combustion would be carbonic acid and water.

However, it has been practically proven that the best welding results are obtained by the use of slightly over 1¼ volumes of oxygen to one volume of acetylene and with this incomplete combustion the products of combustion change and instead of carbonic acid and water being formed carbon monoxide and hydrogen are formed. To this formation of hydrogen, which surrounds and envelopes the point of welding, is attributed the credit for the fact that the oxy-acetylene unlike many of the methods of welding has no injurious effect on the metal.

From the foregoing it will be seen that the cost of the oxygen for the oxy-acetylene torch is materially less than would be calculated. The torch used for oxy-acetylene welding is constructed upon the injector principle in which the oxygen and acetylene are conveyed through separate tubes to within an inch of the point of combustion. The acetylene is usually conveyed direct from the generator through hose connections to the torch at a pressure between 3 and 5 lb. per sq. in. The oxygen is stored in tanks and is used through a reducing valve and hose connections to the torch at between 15 and 20 lb. per sq. in. On the handle of the torch are controlling valves whereby a nicer regulation is attained. For lighting the torch the acetylene is first turned on full and lighted. Oxygen is then added until the flame becomes a single cone. An excess of acetylene produces two cones and a white color while an excess of oxygen produces a violet tint.

The hourly consumption of the torch used for 8 in. steel tubing was 24 cu. ft. of acetylene and 30 cu. ft. of oxygen. Using acetylene direct from the generator at a cost of 1c per cu. ft. and oxygen from tanks at 6c per cu. ft. at which price it is now available in San Francisco, the cost of operating the torch would be $2.04 per hour and allowing 40c per hour for the labor of an operator, the total cost of operation would be $2.44 per hour. As the average time necessary to weld a joint on top of the ditch where the welding is done on top of the pipe is ten minutes, the cost of such welds would be slightly over 40c per joint. The time necessary to weld a joint in the ditch where the operator was forced to weld underneath the pipe was 28 minutes per joint, making the cost of these joints $1.13 per joint. But if the pipe is welded into long sections on the ground it is only necessary to have a weld in the ditch to every ten joints welded on the ground. This would make an average cost of 49c per joint. This would be approximately 2c per inch of circumference on steel tubing 3/16 of an inch thick and from this can be estimated the cost of welding various sizes and thicknesses of pipe as the time per weld and consumption of oxygen and acetylene will increase in proportion to the size and weight of the pipe.

MEETING NOTICES.

J. D. Galloway will speak on Hydroelectric Development in California at the meeting of the San Francisco Section of the American Institute of Electrical Engineers at 8 p. m., September 27, 1912. The meeting will be held in the Pacific Telephone & Telegraph Company's building on New Montgomery and Jessie streets, and will be preceded by a table d'hote dinner at Jules Cafe, Monadnock Building, at 6:15 p. m. At this meeting Henry A. Lardner, vice-president on Pacific Coast relations of the committee on organization of the International Electrical Congress, will make a brief report. This report will be made for the purpose of familiarizing the members of the committee on organization, living in San Francisco and vicinity, and also the general Institute membership, as to the progress which has been made by the committee on organization, and specifically on such matters as have been arranged locally with the Exposition authorities. It is also proposed at this time to effect some permanent organization of the Pacific Coast members of the committee, to the end that the assistance and suggestions of the membership may be received, and that all committeemen may have an opportunity to assist in this important matter.

In accordance with the decision of the Joint Committee of Oregon Society of Engineers, American Institute of Architects, American Society Civil Engineers, American Institute Electrical Engineers, and National Electric Light Association, a luncheon was held at the Imperial Hotel at 12:15 p. m. on Tuesday, the 17th. This date and place is tentatively arranged, but it is proposed to make the weekly luncheon a permanent feature, date and place to be arranged later on. This luncheon is intended to provide an informal meeting place for engineers and architects of all organizations, and it is hoped that as many as possible will be present at all future luncheons.

The Seattle Section of the American Institute of Electrical Engineers will hold the opening meeting of the season and annual dinner in the banquet room at the Rathskeller on Saturday, September 21st. The executive committee and other officers and interested members have formulated a new plan of holding the meetings during the coming winter, which it is believed, will greatly increase their value. It is planned to divide the entire section membership into seven groups and have each group furnish a paper and conduct one meeting. The meetings and papers committee will co-operate with each group in the preparation of the papers and program of its meeting.

The affairs of this section are in excellent shape, and the outlook for profitable work during the coming year is better than for any previous year in our history. The time has arrived when there is serious work ahead for this section, and every member should feel that a portion of the responsibility for having this work well done rests on him.

IN MEMORIAM.

James Dix Schuyler, a civil engineer of international repute, whose works are known around the world, died on September 14 at his home in Ocean Park, near Los Angeles, as a direct result of the great fire there ten days ago. Schuyler had been confined to his beach home for several weeks, but his condition had improved so that he would soon have been out. When the flames threatened his residence he was compelled to suffer the excitement of hasty removal, and from that time he failed rapidly. Schuyler was 64 years of age, and had lived in California forty years. He was a consulting engineer, one of a Panama-canal board of seven, was an assistant State engineer, and had ranked as a foremost California builder. He belonged to all the principal clubs here and many American and foreign technical and scientific organizations. Notable among the engineering problems that he worked out in California was that by which the Great Western Power Company of Northern California succeeded in furnishing light and power to San Francisco and other Northern California cities.


James H. Wise.

James H. Wise, assistant general manager of the Pacific Gas & Electric Company, died at Oakland, California, on Sepember 16, as a result of burns received near Bakersfield, California on the preceding evening.

He died, as he had always lived, in the path of duty. Late in the previous week he had left San Francisco in company with. P. M. Downing, engineer of maintenance and operation for the Pacific Gas & Electric Company, to make an automobile inspection of the Los Angeles aqueduct to get information to be applied in the construction of the great hydroelectric development at the Spalding dam. Shortly after leaving Bakersfield it was found that the gasoline tank was leaking and a stop was made for repairs at Caliente. While Mr. Wise was emptying the tank the gasoline was accidentally ignited from a torch used to heat the soldering iron and the fire was communicated to his clothing. Mr. Downing quickly extinguished the flames, but not until Mr. Wise had been fatally burned. He was at once brought to the Merritt hospital in Oakland, where hopes for his recovery were entertained for a time, but the severeness of the burns finally caused his death in the afternoon.

Mr. Wise was 33 years of age, and a resident of Alameda during his youth. Graduating from the Alameda High School he entered the University of California and graduated with honors in 1903 from the department of mining. After teaching mathematics for a year at the California School of Mechanical Arts he entered the employ of the Pacific Gas & Electric Company in 1904. Serving first as instrument man and later in charge of field work, he was soon made assistant to Frank G. Baum, being promoted to the position of hydraulic and civil engineer when Mr. Baum resigned. Early in 1910 he joined the firm of F. G. Baum & Company, also being retained as consulting engineer for the Pacific Gas & Electric Company. During this period he was intimately connected with the development of several of the great hydroelectric projects of the West and in July, 1911, was appointed assistant general manager of the Pacific Gas & Electric Company, having entire charge of the construction and extension of the new steam and hydroelectric plants which the company is installing.

A man of the noblest ideals, an indefatigable worker and of a most happy disposition, he was beloved and respected by thousands of friends and associates who prized his acquaintance as a most precious possession. Notwithstanding the commanding position which his merit had won he was ever courteous and affable to all. His untimely death has taken from our midst an engineer and an executive whose life work was but begun, whose example forms an eternal inspiration and whose memory will be fondly cherished in the hearts of all.

He is survived by his mother for whom he had built a beautiful home in Berkeley. The funeral was conducted under the auspices of the Berkeley lodge of Masons from his home in Berkeley on September 19.

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CONTENTS

Steam Constants

The use of orchard heaters, evaporators, and frost protectors of various forms, is each year becoming more prevalent in the agricultural districts of the West. Indeed the timely service of these devices saved millions in crops last winter. In order to intelligently and efficiently operate such apparatus many constants of the steam tables must of necessity enter into the computations involved. Professor Alexander McAdie of the Weather Bureau contributes elsewhere in these columns on this important subject.

The most casual review of the fundamental definitions entering into heat computations brings to light an unwholesome lack of uniformity among the framers of our modern steam tables. For instance one authority defines the British thermal unit or B.t.u. as being the quantity of heat required to raise the temperature of pure water at maximum density, 39.1 degrees F., one degree in temperature. Professor Peabody in his revised steam tables states that one B.t.u. is the amount of heat required to raise a similar quantity of water from 62 degrees to 63 degrees F. On the other hand, Marks & Davis in their excellent recent revision of the steam tables have used a unit based upon the one hundred and eightieth part of the heat required to raise a pound of water from freezing point to boiling point or from 32 degrees F. to 212 degrees F. Such a mean B.t.u. is greater than the Peabody B.t.u. and consequently due to this and other reasons a different value for the mechanical equivalent of heat has been used by these authors. Thus, Peabody states that 1 B.t.u. is equivalent to 778 ft. lb. of energy, while Marks & Davis, after a series of delicate weighings of the investigations of many noted scientists, come to the conclusion that their unit B.t.u. is equivalent to 777.5 ft. lb. of energy.

As a matter of ordinary practical importance any one of the above definitions will lead to reasonably accurate results. Still, in modern refined engineering and scientific experiments we should have standard units of measurement adopted by the great engineering societies which should forever put at rest the confusing and varying constants and definitions wandering through the technical and scientific press of the day.

Secretary Fisher's Proposals on Power Appropriations

The latent power of falling water, like the widow's cruse of oil of biblical fame, may be used over and over again, yet from day to day "it diminisheth not." On the other hand, the great natural resources of coal, oil and timber disappear for ever at an almost inconceivably accelerated rate, if wise and far-seeing constructive statesmanship did not prevent. The transmission of electrical energy over distances now reaching the three hundred mile mark has made possible the utilization of hitherto unharnessed powers for the driving of the wheels of industry in concentrated business centers miles from the mountain torrents, whence comes this pulsating energy.

As over 50 per cent of the possible water power

of the United States is situated in states of the Western slope of the Rocky Mountains and as yet only 7 per cent of this power is actually developed as opposed to 36 per cent of Eastern possibilities already harnessed, the question of future power development is indeed a Western problem and one in which citizens of the West are most vitally interested.

From the best source of information we have at hand, it appears that Secretary Fisher proposes to allow future appropriations of power to be sanctioned subject to severe principal provisions which may be briefly summarized as follows:

1. Free permits to issue for the development of water power for municipal purposes and for irrigation.

2. Similar permits to power companies to issue but with rental charges under a definite schedule.

3. Right is retained to readjust these rental charges at the end of each ten-year period.

4. The power companies must submit to regulation of prices and service by authorities of the state in which the power is sold.

5. The power companies are required to surrender their permit on demand of the United States or to transfer to the state or municipality designated by the secretary at any time, but full value of plant and property is to be paid plus a bonus of ¾ of 1 per cent for every year remaining before time of expiration of permit arrives. Thus, if twelve years remain, a bonus of 9 per cent is to be paid.

6. All permits are to expire at the end of 50 years.

The first provision is unquestionably correct and proper, and the second should be likened with it. Power companies have been called into life to fulfill a definite mission. The enormous capital required can only be secured by assurances of a reasonable profit from the undertaking. Hence, this extra tax simply means an extra charge on the consumer or else it places the power company at a disadvantage in operating in competition to muncipally owned projects. Individual initiative is thus blasted. Laws for promoting conservation should secure the people against the loss of their water power, and at the same time should protect capital and enterprise.

Since the second provision is unjust, it follows that the third only creates a still greater hardship for the power company of the future, making still more uncertain the chances of computing ahead of time the returns to be expected from the investment.

The fourth provision is wise and certainly in the great state of California the newly enacted Public Utilities Act is working out in a satisfactory manner many of the hitherto unreconcilable issues between the consumer and the utility company and at the same time security for the investor is attained. The provision, however, should go one step further and state that in case the municipally operated project engages in a general sales business, it too, should submit to regulation by the state authorities. Already, for instance, the war clouds are appearing upon the horizon in Southern California. Here the Los Angeles Aqueduct proposes to furnish water and light to neighboring cities and towns and yet some enthusiasts of this project desire to charge all the traffic will bear instead of the reasonably regulated rates with which other public utility enterprise that are privately owned must comply.

In regard to provision number five, the plan as suggested seems reasonable and in accord with the latest ideas of public utility evolution. Here, too, the municipality should be put also under the same clause. The time is coming and not very far distant when the larger and more scientifically operated unit —state-wide ownership—will become a proper basis for advancing the economic value of publicly operated hydroelectric networks. Under such a scheme the municipality must with the privately owned enterprise give way to state-wide control and perhaps ownership. Hence the necessity for this provision. It is doubtful whether the particular bonus offered is fair and adequate. Some enterprises offer more hazard than others. The appraised price of purchase should be determined by a commission such as the Railroad Commission of California and should include a physical valuation of so much of the utility works as are used and useful in the business of the utility. This appraisal should allow for a reasonable promotion expense and should include capitalization of interest charges during construction. No value for the franchise or license should be allowed and capitalization of deferred earnings should not be included as the bonus system inaugurated under the clause should amply satisfy the want.

In the sixth provision, a time limit is set for an ultimate expiration of the franchise. A power enterprise is either a necessity in a community or else during later years retrogression has caused its usefulness to cease. If the power—so long as the enterpise is publicly regulated as to service and rates as set forth in provision four—no valid reason exists for making an arbitary termination at the end of fifty years, especially since provision five states that the utility may be publicly taken over at any time. On the other hand, if retrogression has taken place in the community, the enterprise will die naturally without official execution on the part of the Secretary of the Interior. In a word the socalled "indeterminate franchise" of the Wisconsin laws, which is today fulfilling so efficiently the exigencies of power development is what is needed generally instead of the arbitrarily fixed period of use.

It is to be hoped that the authorities at Washington will still further review the subject at issue in the hopes that Western needs may the better be met.

PERSONALS.

Jesse W. Churchill, president of the California-Oregon Power Company, is at San Francisco from Yreka.

H. A. Lardner, manager of J. G. White & Co.'s San Francisco office, is making an inspection tour of Southern California.

F. E. Vickers, Pacific Coast inspector of turbines for the General Electric Company, is visiting the works at Schenectady, N. Y.

H. V. Carter, president of the Pacific States Electric Company, is making an extensive business trip throughout the Northwest.

C. O. Poole, of the firm of Manifold & Poole, engineers for the Southern Sierras Power Company, has been visiting San Francisco.

Fred L. Webster, Pacific Coast manager for the Allis-Chalmers Company, is on his way to the factory at Milwaukee for a two weeks' visit.

C. W. Abbott, engineer for the National Metal Molding Company, is making a trip through California. This week he addressed the Jovian lunch club of San Francisco.

George G. Moore of Detroit is at San Francisco with two friends who are en route to Northern Canada in search of big game. Moore has large electric traction interests in Atlanta, Ga., and Mobile, Ala.

Leslie Hawken, who is connected with the Telephone-Electric Equipment Company, in charge of the Simplex line of healing apparatus, manufactured by the Simplex Electric Company, is making a business tour through California.

Douglas J. W. Metcalf, formerly an electrical contractor at Seattle, has been appointed assistant superintendent of the Calgary Light & Power Company, and will make his headquarters at the generating station, Kananaskas, Alta.

J. McA. Duncan, formerly assistant manager of the Westinghouse Electric & Manufacturing Company's works at East Pittsburg, has been appointed district manager at Pittsburg. He succeeds W. F. Fowler, who has joined the W. S. Kuhn force.

George G. Devore, local manager at Georgetown, Cal., for the Truckee River General Electric Company, Loon Lake district, spent the past week at San Francisco, making his headquarters with the Stone & Webster Construction Company.

J. B. Black, formerly in the general sales force of the Great Western Power Company, has been promoted to power salesman of the San Francisco division. Mr. Black graduated from the College of Mechanics of the University of California only last May.

John A. Britton, general manager of the Pacific Gas & Electric Company, recently gave a most interesting public stereopticon lecture at the McDonough Theatre, Oakland, on the construction work of the company now under way at Lake Spalding.

Alexander Christie, assistant professor of mechanical engineering at the University of Wisconsin, was a recent interested visitor at the University of California, Berkeley. Mr. Christie is just returning from Western Canada, where he has had in charge the installation of a large steam turbine.

Hugh McPhee, a commercial superintendent of the Western Union Telegraph Company, with headquarters at Los Angeles, spent several days at San Francisco during the past week attending a conference of telegraph heads of departments, including Messrs. Dodge and Mays.

E. G. Williams, chief construction engineer of J. G. White & Co., of New York, returned during the week from an inspection of the work in progress for the Mt. Hood Railway, Light & Power Company in Oregon, and he is now looking over the route of the Oakland, Antioch & Eastern Railway through the Sacramento Valley.

J. P. Ault, who is connected with the Carnegie magnetic survey, left during the week for Tahiti to relieve W. J. Peters, who is now in charge of the investigation. In 1905 the work of making a new chart for navigators was commenced off San Francisco on the steamer Galilee. The "Carnegie," the vessel now employed on the survey, is absolutely non-magnetic.

G. E. Prendergast, chief engineer of the Pacific Navigation Company's turbiner Harvard, has tendered his resignation, effective in October, in order to accept the position of superintendent and supervising engineer of the new Standard Oil Building on the corner of Bush and Sansome streets, He is one of the youngest marine chiefs on the Pacific Coast.

Sidney Sprout, consulting engineer for the California-Oregon Power Company, has returned to San Francisco after visiting the new power site on the lower Klamath River. The working force on the big dam at Ward's Canyon has been temporarily reduced on account of delays in the arrival of some of the material. However, work will be prosecuted continuously and the plant may be completed next spring instead of in December of this year.

TRADE NOTE

Hunt, Mirk & Company are installing at Los Angeles an additional 5,000-kw. Westinghouse Parsons turbo-generator for the Los Angeles Aqueduct. C. W. Baker, the district erecting engineer, is in charge of the work.

NEWS OF THE CALIFORNIA RAILROAD COMMISSION.

On Septemher 7th a general order was issued for all public utilities to file such rates as depart from the standard schedule occasioned by such matters as contracts for right of way, etc., employees, charitable uses, educational purposes, etc.

On September 10th, the Central California Gas Company made application to issue $32,000 in bonds and $19,200 in stock to build a transmission line from Exeter to Visalia, Tulare County, and for additions to the gas plant at Visalia and the distributing stations in Visalia and Tulare.

On September 11th, the Commission rendered a decision granting to the Santa Barbara Gas and Electric Company permission to sell $5000 of bonds. The Pacific Electric Railroad Company of Los Angeles applied to the Railroad Commission for blanket authority to issue bonds in the sum of $79,161,000 for refunding and new construction. The Arrowhead Reservoir and Power Company of San Bernardino County applied to the Commission for permission to issue bonds in the sum of $4,000,000 to complete its water system.

On September 12th, the Big Four Electric Railroad Company of Tulare County was given permission to sell 100,000 shares of its capital stock of the par value of $100,000, for the purpose of building an electric railway in Tulare County, 34 miles in length. The company is required to raise from stock $50,000 before prosecuting construction work. Announcement was made that the Commission had in preparation a general order requiring all public utility corporations to preserve all records. The Willitts Water and Power Company filed a reply to the complaint of the town of Willitts, denying unreasonable practices and excessive rates.

On September 13th, the Great Western Power Company filed its answer to the complaint of the Pacific Telephone and Telegraph Company which had alleged interference by induction with its lines between Napa and Vallejo. The Great Western Power Company denies the induction charge. The Pasadena Lake, Vineyard, Land and Water Company and the North Pasadena Land and Water Company filed an application, in which the city of Pasadena joined, to sell their respective water plants to the city of Pasadena; the Pasadena Lake, Vineyard, Land and Water Company for $621,622.31 and the North Pasadena Land and Water Company for $194,217.83. The city of Pasadena recently voted bonds for a water plant of $1,250,000. Hearing was held upon application of the Pacific Gas and Electric Company to sell general and refunding mortgage bonds in the sum of $5,000,000.

N. W. ELECTRIC LIGHT AND POWER ASSOCIATION CONVENTION.

The fifth annual convention of the Northwest Light and Power Association was held at Portland, Oregon, September 11, 12 and 13, 1912. The following program was announced:

Wednesday, September 11th.

Address of Welcome—Edgar Piper, President Portland Commercial Club.
Response by the President.
President's Annual Address.
Report of Secretary and Treasurer.
Report of Auditing Committee.
Reports of Committees.

"Is Residence Lighting Profitable?"

Editor—
O. V. Snyder, Seattle, Wash.

Associate Editors—
M. C. Osborn, Spokane, Wash.
H. D. Gates, Hillsboro, Oregon.
H. R. Kingman, North Yakima, Wash.
Stacy Hamilton, Portland, Oregon.

"Justification of a Rate."

Editor—
D. C. Barnes, Everett, Wash.

Associate Editors—
A. S. Grenier, Portland, Oregon.
Leslie Coffin, Bellingham, Wash.
C. E. Groesbeck, Portland, Oregon.

Thursday, September 12th.

"Uniform Classification of Accounts for Electric Light and Power Companies."

F. Shaw Baker, Assistant Treasurer Butte Electric and Power Company.

"Intangible Values of Electric Lighting and Power Properties."

William J. Hagenah, Public Utility Statistician. (Former member of Wisconsin Public Service Commission.)

"Reciprocal Duties of the Public Service Corporations and the Public."

Colonel C. E. S. Wood, of the Multnomah County Bar.

"Public Service Commissions."

Franklin T. Griffith, Portland, Oregon.

"Scientific Operation of a Central Station."

Editor—
O. B. Coldwell, Portland, Oregon.

Associate Editors—
D. F. McGee, Portland, Oregon.
George E. Quinan, Seattle, Wash.
Victor Greisser, Spokane, Wash.

Friday, September 13th.

"Relative Value of the Commercial Department in Central Station Service."

Editor—
A. F. Douglass, Portland, Oregon.

Associate Editors—
M. D. Spencer, Everett, Wash.
A. C. McMicken, Portland, Oregon.
H. S. Wells, Portland, Oregon.
Lewis A. Lewis, Spokane, Wash.

"Use of Electric Power for Irrigation and Other Rural Purposes."

Editor—
George C. Arrowsmith, North Yakima, Wash.

Associate Editor
Arthur Gunn, Wenatchee, Wash.

Executive Session—Election of Officers.

President Davidson, in his annual address, reviewed the excellent work of the association during the past year and suggested ideas for future action, not only in increasing the membership, but also in perfecting conditions so as to actually promote a closer relationship with the public. Particular stress was laid on the desirability of securing members among university and college authorities and thus promote a proper understanding of corporation methods among the rising generation.

The routine duties of the association officials were discussed and proposals made for their more efficient accomplishment, including a news service, statistical information and circular letters to members.

The work of the several appointive committees was discussed and a tribute of appreciation paid to their work and to that of the secretary.

Some little attention was given to the good effects of the affiliation with the National Electric Light Association and the Seattle convention. The subject of resuscitation from electric shock and means for giving a wider knowledge of its methods was described in detail. Regarding public service commissions the speaker stated:

"The officers of many utility companies view regulation with disapproval, but I feel I voice the sentiments of the majority when I say we are in accord with fair and efficient state regulation. The Public Service Commission of Washington took up its duties on January 1st of this year. In Oregon, the public utility bill was passed by the last legislature, but it has been referred to a vote of the people and is not yet a law. In the coming fall election, it will be voted on, and the concensus of opinion is that it will undoubtedly be passed, which will broaden the powers of the Railroad Commission, the law being retroactive to January 1st, 1911. This being true, we will then have state regulation in both Oregon and Washington."

President Davidson concluded his address with a strong plea for fair and above-board dealing with the public and thus create more favorable public relations.

The various other papers, which will be published in future issues of this journal, were thoroughly discussed. Perhaps the most valuable paper of the convention was that of Mr. Wm. J. Hagenah, which will long stand as a classic on the subject of corporation regulation.

The election of officers resulted as follows: President, W. J. Grambs, Seattle; Vice-President for Idaho, J. J. Jennings, Lewiston; Vice-President for Oregon, A. C. McMicken, Portland, Executive Committee, O. B. Coldwell, Portland; Douglas Allmond, Anacortes; Elmer Dover, Tacoma.

While much business was accomplished there was also considerable enjoyment interspersed.

ENTERTAINMENT.

Wednesday, September 11th.

At 8 p. m. the delegates and their families went to The Oaks Amusement Park where special entertainment features were provided. The program was in charge of the Portland section of the Jovians and "High Jinks" was chairman of their committee. There were refreshments for the thirsty and hungry, and dancing for those so inclined.

Thursday, August 12th.

An automobile ride throughout the city was given all visiting ladies. At 8 p. m. a rejuvenation was held by the Portland Jovians.

In this rejuvenation thirty-five candidates became Sons of Jove. Those receiving the most marked honors were C. J. Franklin, A. C. McMicken, Mr. Wessinger, E. W. Bonness, Max Wood and Walter Ayden. The rejuvenation was preceded by a parade through the Multnomah Hotel headed by "the hungry seven" and was followed by a joviation when a number of unworthy rejuvenated satellites received their just deserts from Lucifer, admirably impersonated by E. A. West. The degree team was as follows:

Jupiter, C. P. Osborn
Neptune, L. R. Elder
Vulcan, N. W. Brockett
Pluto, E. A. Whitney
Mars, W. H. Wall
Hercules, C. R. Dederick
Apollo, Carl Wernicke
Mercury, Geo. Sailor
Imps, Wells, Parker, Ryan, Barker, Fehr

Friday, September 13th.

At 8 p. m. the annual banquet of the Association was held in the banquet hall of the Multnomah Hotel. While the banquet was in session the ladies of the convention were the guests of the Association at the Orpheum Theatre.

The log sheet at "the Multnomah substation" showed the diet to be made up of frequency changers, submarine insulation, boiler compound, transit oil, and various other unusual concoctions. B. S. Josselyn acted as plant superintendent and C. C. Chapman, W. W. Cotton, Wm. J. Hagenah and W. O. Johnson as substation attendants.

Saturday September 14th.

All delegates and their families were the guests of the Portland companies at an old fashioned picnic at Estacada Park. The River Mill and Cazadera plants of the Portland Railway, Light & Power Company are located here, and an opportunity was given to all to inspect these plants.

The Central Station men crossed bats with the Supply Companies.

The registration list, exclusive of a large number of representatives from the Portland Railway, Light & Power Company and the Pacific Power & Light Company, was as follows:

Douglas Allmond, Anacortes Water Co.
Geo. Arrowsmith, Pac. P. & L. Co.
B. P. Bailey, Pac. P. & L. Co.
G. N. Barker, G. E. Co.
W. N. Birney, Westinghouse Co.
H. L. Bleecker, W. W. P. Co.
A. M. Boykin, Wash.-Ore. Cor.
C L. Brown, Kenton Trac. Co.
E. W. Bonness, N. W. Elec. Co.
N. W. Brockett, P. S. T. L. & P. Co.
H. V. Carter, Pacific States Elec. Co.
C. E. Canada, G. E. Co.
D. E. Campbell, Vote Berger Co.
M. G. Carhart, Gt. West. Pr. Co.
C. E. Condit, N. W. Elec. Co.
A. M. Chitp, Everett R. L. &. W. Co.
O. O. Colderhead, Wash. Public Service Commission.
O. B. Coldwell, P. R. L. &. P. Co.
W. H. Crawford, C. C. Moore Co.
R. E. Davis, Pac. P. & L. Co.
J. E. Davidson, Pac. P. & L. Co.
R. F. Dean, Hood River Gas & Electric Co.
A. H. Douglas, H. M. Byllesby Co.
H. B. Dunn, P. S. T. L. & P. Co.
H. E. Duren, G. E. Co.
W. C. Earle, Oregon Railway Commission.
P. J. Edwards, Yamhill Electric Co.
H. T. Edgar, P. S. T. L. & P. Co.
S. S. Einstein, Spec Device Co.
L. R. Elden, G. E. Co.
A. A. Elrick, West. Elec. Co.
Eugene Enloe, Big Bend Lt. & Pr. Co.
L. B. Faulkner, Olympia Lt. & P. Co.
J. D. Fellows, Harney Valley L. & P. Co.
L. G. Fehr, Westinghouse Co.
G. E. Gay, Pac. P. & L. Co.
O. B. Gates, Prairie L. & W. Co.
W. J. Grambs, P. S. T. L.& P. Co.
H. L. Gray, Wash. Public Service Commission.
V. H. Greisser, W. W. P. Co.
J. S. Gror, N. W. Elec. Co.
S. B. Gregory, Arrow Elec. Co.
L. R. Grant, P. S. T. L. & P. Co.
Arthur Gunn, Wenatchee Valley Gas & Elec. Co.
A. H. Halloran, Journal of Electricity.
H. A. Hart, Olympia Lt. & Pr. Co.
L. V. Harper, Chelan W. P. Co.
W. J. Hagenah, Chicago.
A. S. Hall, Hood River Gas & Elec. Co.
H. H. Hall, H. W. Johns-Manville Co.
O. B. Helt, G. E. Co.
C. R. Hemerick, Fobes Supply Co.
G. H. Humphries, P. P. & L. Co.
Doug. Huntington, P. S. T. L. & P. Co.
W. L. Ingalk, Pac. States Electric Co.
A. T. Irwin, Idaho-Wash. L. & P. Co.
J. J. Jennings, Lewiston-Clarkston Imp. Co.
R. F. Jennings, Oregon Pr. Co.
W. O. Johnson, Consult. Engr., Portland.
I. Jump, Westinghouse Co.
B. L. Karns, Westinghouse Co.
L. D. Kelsey, Aberdeen.
J. B. Kilmore, Pac. P. & L. Co.
J. M. Kincaid, Key City L. & P. Co.
F. M. Kolloch, Westinghouse Co.
G. A. Krimler, G. E. Co.
G. A. Lee, Wash. Public Service Commission.
W. R. Lyall, D. & W. Fuse Co.
A. M. Mechlein, Wash. Public Service Commission.
G. A. Martin, Yamhill Elec. Co.
S. McComber, City Engr. Centralia.
McKissick, N. W. L. & W. Co.
A. S. Moody, G. E. Co.
R. F. Monges, G. E. Co.
H I. Miller, Pittsburg Meter Co.
L. A. McArthur, Pac. P. & L. Co.
D. F. McGee, Pac. P. & L. Co.
A. C. McMicken, P. R. L. & P. Co.
O. B. McCriax, Wenatchee Valley Gas & Elec. Co.
H. E. Norton, Oregon Pr. Co.
G. L. Nevins, Pac. P. & L. Co.
F. D. Nims, West. Canada Co.
A. V. Olsen, Folles Supply Co.
B. Olsen, G. E. Co.
M. C. Osborne, W. W. P. Co.
A. A. Parker, G. E. Co.
L. C. Parks, Oregon Pr. Co.
H. E. Plank, G. E. Co.
W. D. Pearlee, G. E. Co.
A. E. Ransome, Olympia Pr. Co.
J. H. Ralston, Ralston Elec. Supply Co.
M. Ray, Hood River Gas & Elec. Co.
J. A. Rolph, Hermiston Lt. & Pr. Co.
E. G. Robinson, Jim Creek W. L. & P.
A. J. Ruel, North Idaho & Montana Power Co.
G. R. Sailor, Westinghouse Co.
W. T. Sachtliken, Bremerton Charleston Lt. & Pr. Co.
F. M. Shields, Idaho-Wash. Pr. Co.
I. A. Shornio, G. E. Co.
H. R. Simonds, W. W. P. Co.
W. Spalding, Tillamook Elec. Lt. & Fuel Co.
H. C. Stoddard, Calif.-Oregon Pr. Co.
M. D. Spencer, Everett Gas Co.
C. T. Terrell, P. S. T. L. & P. Co.
F. C. Todt, Pac. States E. Co.
J. R. Townsend, E. E.
C. M. Wright, Peerless Lamp Wks.
H. P. Weaver, Inspect. Bur.
C. T. Wernicke, Westinghouse Co.
J. L. White, Dallas, Ore. Pr. Co.
E. L. Whitney, G. E. Co.
L. M. Whittington, Westinghouse Co.
L. A. Wallen, P. S. T. L. & P. Co.
H. S. Wells, Pac. P. & L. Co.
H. B. Zimmerman Grays Harbor P. & Lt. Co.
C. B. Young, Pac. P. & L. Co.

CONVENIENT CONVERSION TABLE FOR FROST WORK.

BY A. G. McADIE.

Orchard heaters, evaporators and frost protectors of various forms have come into such widespread use that a convenient table for the quick conversion of heat units into power units, and vice versa, seems to be much needed.

It may be pointed out that the British thermal unit, as defined most recently by Marks & Davis in their steam tables, is 1/180 of the quantity of heat required to raise one pound of water from 32° F. to 212° F. This is the unit most frequently used by engineers in this country and Great Britain, although it is desirable that the old English units and the Fahrenheit scale be used as little as possible. A British thermal unit is equal to 0.252 calorie and also equal to 777.5 foot-pounds. One therm will raise the temperature of 1 gram of water 1° C.; 1,000 therms equal 1 calorie, equal to 3,968 British thermal units.

In problems connected with the heat of water, it should be remembered that the total heat is the latent heat plus the sensible heat. The total heat required to evaporate water at a given temperature is $1{,}059.7 + 0.428$ T, where T is given temperature. This holds for temperatures between 32° F. and 212° F.

In changing to steam at 212° F., a pound of water at 212° F. absorbs 970.4 British thermal units and the total heat is therefore 1,150.4 British thermal units. This is starting from a temperature of 32° F. A pound of ice at 32° requires 142.4 British thermal units to change into water at 32° F.

The latent heat of aqueous vapor may be found from the following formula:

$$L_a = 1{,}091.7 - 0.572\, t_a$$

Where L_a = latent heat

t_a = temperature of water.

For convenience in frost work the following may be used:

1 kilowatt-hour = 3,412.66 B.t.u.
1 H.P. = 746.3 watts.
1 H.P.-hour = 2,544.6 B.t.u.
1 B.t.u. = 777.5 foot-pounds.
1 B.t.u. = 0.252 calories.
1 calorie = 1,000 therms.
1 colorie = 3.968 B.t.u.
1 calorie per kilogram = 1.8 B.t.u. per pound.
1 pound of air at 32° F. occupies about 12.4 cubic feet.
1 pound of water at 212° F. occupies about 0.0160 cubic feet.
1 pound of steam at 212° F. occupies 26.79 cubic feet.
1 pound of water at 212° F. occupies 180.00 B.t.u.
1 pound of steam at 212° F. contains 1,150.4 B.t.u.
1 pound of ice requires 148.8 B.t.u. to change to water.
1 cubic foot of water at 212° F. weighs 59.84 pounds.
1 cubic foot of water at 62° F. weighs 62.2786 pounds.
1 cubic foot of steam at 212° F. weighs .03732 pound.
1 cubic foot of dry air at 0° C. weighs 1,293.05 grams.
1 cubic meter of dry air at 0° C. weighs 1,293.05 grams.
Specific heat of water, 1,000, (as an average between 32° F. and 212° F.).
Specific heat of ice, 0.489.
Specific heat of water vapor, 0.453 at atmospheric temperatures.
Specific heat of air, 0.241.

Values given above are laboratory values, obtained by using distilled water. Ordinary drinking water is heavier than distilled water, because of matter in solution. Salt water is also heavier. It may also be remarked that the temperature of the freezing point in ordinary use, i.e., 32° F., or 0° C., may not hold for the freezing of water in plant life. W. N. Shaw instances one plant where the freezing point is apparently 21° F. In other words, the change of water from the liquid to the solid state under natural conditions is somewhat different from the change as studied in a laboratory.

Note.—Some of the values given above differ slightly from those found in textbooks, but it is believed they are the most recent.

THE LATENT POSSIBILITIES OF THE ELECTRICAL DEVELOPMENT LEAGUE.[1]

BY W. W. BRIGGS.

The president of the League asked me on Thursday of last week to prepare a paper on some subject for this meeting. I must crave your indulgence, however, in this presentation of the large subject selected, as I have barely skimmed the field, owing to the limited time afforded in its preparation.

I feel that the time has arrived when the possible scope of this organization might properly be discussed. That an organization of this kind would be of service to the electric industry in and about the city in which we live, is indicated by the rapid growth of this one.

Probably owing to this growth, collective attention has not been given to the possibilities of general good to the electric industry that are latent in such an organization, and it is further possible that, if our ideas were directed to the channels where this organization could stand sponsor for the different trade and social organizations of the electrical industry, a greater general benefit might be secured.

We all remember the ancient fable of Aesop and the bundle of fagots. We, in a sense, have a similar condition in our local electrical industry.

The central stations have their problems and the manufacturer, dealer, jobber and contractor each have theirs, but the welfare of any or all of them are more or less co-related.

Thus, any condition that develops, adverse to the interest of the central station industry, will be reflected along the line and felt by all other allied interests. Ill-considered, adverse legislation, effecting the securities or management of public service corporations, tends to restrict the development, which condition is at once reflected in a general trade depression—the manufacturer finds his apparatus orders falling off—the contractor finds little or no work to do where extensions of service are not under way, and the jobber and dealer finds their business lessened in consequence.

Unfair and arbitrary rulings and inspection by the city or underwriters' authorities, unduly harrass the contractor, involving him in unnecessary and unforseen costs, placing his industry on an unstable basis, reflected in reduction of working surplus and restriction of credit. The indirect effect of costs and delays incidentally are again felt by the dealer and jobber in the unstable credit situation, obsolescence of stocks, etc.

It often occurs that the authority under city or underwriters' inspection, is placed in the hands of individuals incapable of clear interpretation of the regulations and from whose ruling, there is no appeal.

There are many regulations incorporated in such rules, that fail of their purpose of safe-guarding the consumer and reducing the fire hazard, and which regulations would appear to have been incorporated for the principal purpose of favoring some patented article.

Let us now consider the possible remedy for this character of ills.

We must first, firmly fix in our minds that this organization is formed for the principal purpose of advancing the electrical industry and that such a result cannot be accomplished by anything but by a policy of standing firmly on a plank of fair and equitable treatment to all with whom we come in contact. We should have no time for anything that smacks of trick or device, but support only such policies as make for advanced conditions in every sense of the word.

Take for instance, the case as above mentioned, of ill-considered and inadequate legislation on the part of a governing body, such as would unjustly affect a central station. The presentation of a protest by that central station, as an individual company, would probably have limited effect, owing to the feeling that this one station had an "ax to grind." However, should that station be a member of an organization such as ours, and have discussed the condition with our committee, and finally, through that committee, has presented the matter to this body and received its unqualified endorsement, then, when presented to a governing body, backed by the weight of opinion of the electrical industry as represented by our organization, believe me, they will be heard with a degree of interest not possible through other means.

Consider also the possibility of the inspection bureau, having an inspector improperly equipped either in technical knowledge or temperament to properly administer his duties. A complaint, no matter how well founded, emanating from a contractor or a number of contractors, would have comparatively small weight, as the complainants would be the parties directly interested. Could this matter have been referred to our organization and have received its calm and judicial study, a protest from such a body would carry much weight.

In this field, then, there is a possibility of great good being accomplished by this organization, and in consequence, added opportunities for the development and advancement of our business, due to our solidified presentation of such matters.

I would suggest that consideration be given to possibilities of development under this head, and that it be considered the duty of our grievance committee to take up, study and report on such matters as might be brought to their attention from time to time by our membership.

It is possible that the name of this committee could properly be changed to that of public policy committee, with duties similiar to that of tht same committee of the National Electric Ligh Association, but confining their efforts to our local situation.

There are many other things that could be developed by our initiative in this line of endeavor, such as the formulation and advocacy of amplified wiring regulations, to care for the growing appliance and electric sign business; the preparation of papers issued under authority of this League, which would interest architects, engineers and others, and point out to them the desirability of caring for appliance and sign loads when laying out building and residence wiring.

As I once said to you in an informal talk, let us disabuse our minds of the impression that we have a "God Given Right" to be in the electrical business.

In these days no one can succeed by hanging out a sign and sitting back complacently and feel that he must thrive because of his sign.

This applies to every interest here represented, and one of the greatest things that this League can accomplish, is to so stimulate its membership that they will put behind them, old, worn-out traditions and bring to bear on collective and individual interests, the necessity of being up and doing in creating new business.

The jobber, dealer and contractor have no justified complaint to make when a central station enters the appliance field and apparently takes business from them, when they (the jobbers, dealers and contractors) are satisfied to sit back and take care of such business as offers without an effort to stimulate the demand, or when they take no pains to see that appliances of proper voltage, etc., are supplied. The central station wants to sell the energy, and if those to whom, in the natural course of events, the appliance business belongs, will not fill their function, the central station is justified in so doing.

Similarly, the consulting engineers should not complain if the manufacturer and his engineers encroach on their field, when they, themselves, will not properly fill it, and apparatus and energy sales lie dormant, awaiting some one with initiative to inspire their uses.

Ethics to the contrary, the time has passed when any field of endeavor remains closed to other activities, when one or more interests must suffer because of the failure of a

[1]Presented before Electrical Development League, San Francisco, Sept. 10, 1912.

branch of the industry to properly fill the space allotted to it in the original scheme of things.

I am impressed with the fact that a large part of our energies (and this condition is not necessarily confined to the electrical industry) are expended in endeavoring to take from each other, business already created, rather than looking afield and seeking where our activities might better be expended in the development of new applications.

In this organization we can accomplish much in this desired direction, by collective thinking. To be sure, the interests represented here are largely competitive—but what of that—a stimulus given by any one's initiative will bring him a just reward, and still the business, as a whole, will have been improved and everyone ultimately secure his relative share of the development.

As a case in point, I might quote from a personal experience:

I placed in effect with the local office of the interest that I have the pleasure to serve, some policies, which involved a considerable expense for the purpose of developing a certain demand for apparatus and through our efforts and reports, a number of prospective customers were interested. It so happened that we did not secure a single contract from the first five negotiations handled, but our competitors did, and also the central stations.

New business was created, although my men were temporarily discouraged. But, some of the central stations recognized the pioneer work that had been done and awarded us business that we had not previously enjoyed, which compensated us in a very large measure.

There is a vast field for development of new business along electrical lines in and around these communities, in which the membership of this organization are interested, and I feel that through an interchange of ideas by papers presented at these meetings—by a mutual understanding of each others' problems, the initiative necessary to develop new business, may be stimulated.

Possibly it might be considered as one of the duties of your "Ways and Means" committee to study such possibilities, and from time to time submit reports that would point out to the membership, matters for consideration, wherein concerted action on the league's part, would stimulate business.

Again, let us emphasize that we all owe a duty to the public and our customers and consumers, to safe-guard their interests.

The contractor who would, for a temporary profit, advocate the use of an improper or antiquated device or wiring system, the dealer, jobber or manufacturer who would, to clear his stock or for other reasons, furnish the customer with improper lamps or other devices, or the central station who stoops to misrepresentation to secure a contract, have no place in this organization and are not entitled to its support.

In the disposition of our commodities, whether they be energy, appliances or machinery, let us not advocate taking the path of least resistance to secure contracts or orders, but rather study our customers' requirements and give them the benefit of our knowledge and experience, to the end that, from our activities in our chosen field of endeavor they will secure a maximum of service at a minimum of cost.

I would further strongly advocate that this league be considered (for the local district) as the parent commercial organization of those interested in the electrical industry. We have diversified interests in our midst, who, of necessity, have many intimate problems to discuss and so vast are these that they could not receive proper consideration at our meetings, and for that reason have their separate organizations. However, a great need exists for a strong central body where every local electrical interest can join and I believe we have this organization in the Electrical Development League.

Might we not logically consider that for the local electrical industry, the league be considered the central body, offshooting from which we would have such organizations as—

The Energy Club, represented by the central stations and power salesmen and those interested in the disposition of energy.

The Jovians, a national organization, might be considered as the right bower of the local Electrical Development League and the social branch of its activities.

The jobbers and contractors, The American Institute of Electrical Engineers, The National Electric Light Association, are all national bodies and are thoroughly organized. For our interests they can, with propriety, co-operate with this league in fostering the industry locally and assist us to put up a substantial and solidified presentation of a cause, where such need exists.

It is further possible that, as the league develops and becomes stronger, it might affiliate with the local chamber of commerce and thus secure the potential benefits of that still larger organization.

To secure the desired result in connection with an organization of this character, requires the unqualified support and endorsement of its activities by its entire membership.

You have had given to you an example of the capacity of this league, in entertaining visiting guests interested in the electrical business, such as the entertainment afforded travelers through this city on their way to the National Electric Light Association Convention. This is another function where the league serves the purpose of uniting all of the electrical interests in one compact organization to assist in the entertainment of electrical people who, from time to time, may visit us, creating a most favorable impression throughout the country and reflecting credit on our city and industry.

I feel that I have but briefly sketched a few of the possibilities of the Development League, but that perhaps one or two of the ideas here expressed, may be of service in molding your opinions as to the benefits that may accrue to all concerned.

ELECTRICAL CONTRACTORS' NOTES.

The National Electric Company has obtained the contract for wiring the Patrick Henry School.

The wiring of Nathan, Dohrman & Co.'s warehouse on Bluxome street, south of Fifth, was awarded the Decker Electric Company for the sum of $1673.

Bids are being taken for the Insurance Exchange Building at California and Leidesdorf streets. The electric work will run close to $15,000. Willis Polk Company are the architects.

The Butte Engineering & Electric Company was awarded the contract for the completion of the electrical work on the San Francisco City and County Hospital for the sum of $11,800.

A luncheon was given Thursday, September 12 by the secretary of the Electrical Contractors to Engineer Guy Bayley of the Panama-Pacific Exposition Company. The contractors listened very attentively to Mr. Bayley's version of how the engineering work will be handled. Those present were Guy Bayley, Frank Watts, C. F. Butte, L. C. Ames, Nelson Hope and W. S. Hanbridge.

The John G. Sutton Company was awarded the wiring contract for Shreve's new factory, on the southwest corner of Bryant and Zoe streets. The contract price was $9136. A feature of this factory worth mentioning is the fact that each machine has a separate motor and that all machines are set on separate piers, built up from the foundation and independent of the building, so as to do away with all vibration.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—Presto Electric Company, $500,000, shares $10 each, subscribed $50, by S. A. Fairchild, M. Meagher, E. Barats, S. J. Brun and J. W. Schmitz.

ARTESIA, N. M.—The Artesia Light & Power Company, whose stock was purchased by John C. Keys of Oklahoma City, is being succeeded by the Pecos Valley Gas & Electric Company, which is being incorporated by Mr. Keyes. The new company has power to make and dispose of gas and electricity, sink wells, install pumping plants and may construct and operate an electric railway.

RENO, NEV.—It has developed that the incorporators of the Sierra Telephone & Telegraph Company, which is seeking a franchise for a telephone line in this city, are T. F. Dunaway, vice-president of the Nevada-California-Oregon road; H. G. Comstock, a real estate man, and E. F. Brown, a local attorney. It is also stated that a Portland capitalist is behind this move and that it is to be part of a new telephone system in the Western States.

TULARE, CAL.—Revised articles of incorporation have been filed by the Big Four Railroad, in view of the ratification of the proposed enterprise by the officials of the Porterville Chamber of Commerce, and the determination of the directors to proceed at once with the construction of the railroad to the citrus district through the Poplar dairy country. The capital stock of the new company appears at $500,000 in the revised articles. Four directors have been added to the board, the new ones being W. F. Ingerson, a Visalia merchant; C. A. Whitmore, a Visalia newspaper owner; H. W. Hannaford, a Tulare district property owner, and J. W. L. Marsna, a Tulare district rancher.

ILLUMINATION.

LOS ANGELES, CAL.—Plans are under way for placing specially designed electroliers through the Country Club park.

GLENDALE, CAL.—The lighting system of this city is to be extended immediately into Verdugo canyon, recently annexed to the city.

RIVERSIDE, CAL.—There were no bidders for the installation of an ornamental lighting system and the city officials figured on the job and awarded the contract to the city.

LOS ANGELES, CAL.—Fire in the showroom of the Southern California Edison Company, at 55 E. Colorado street, Pasadena, did damage estimated at $10,000 in that establishment.

SACRAMENTO, CAL.—The construction of the new Pacific Gas & Electric Company's building on the southeast corner of Eleventh and K streets will be started soon. The building will be four stories high, steel frame with pressed brick and terra cotta exterior.

MARYSVILLE, CAL.—The Oro Light & Power Company has filed with the Supervisors of Yuba County an application for a 50-year franchise to operate its business in this county. It asks to be permitted to erect poles on the highways and stretch wires in the streets and alleys of the city.

SAN FRANCISCO, CAL.—The postponed hearing of the application of the Pacific Gas & Electric Company to the Railroad Commission for permission to issue $5,000,000 of its general and refunding mortgage bonds for the development of its power and irrigation systems on Bear and Yuba Rivers, began last week before Commissioner J. M. Eshleman. At the close of the hearing, President Eshleman said that he would decide the matter promptly. The most interesting testimony from a financial standpoint, was John A. Britton's explanation of the care exercised by the Bankers' Trust Company of New York, which is advancing the needed funds for the construction work, in subjecting all items to careful scrutiny, Mr. Britton said: "First, every item and voucher are carefully examined by our own officials, checked, and assigned to capital account or operating account. Then a representative of the Bankers Trust goes over them. Finally, an Independent firm of accountants checks every item and examines every voucher. Not until all this has been done do we receive the money." Assistant General Manager J. H. Wise testified that the power to be developed with the funds to be secured by the sale of these bonds would equal 40,000 kw., of which 20,000 kw. would be utilized in supplying Folsom and the other 20,000 would take care of the growth this year and next. In the course of the hearing it was brought out that it is the intention of the company in the near future to apply for permission to issue another $7,000,000 in bonds to finance the construction of irrigation and power works along the Bear River and at Lake Spaulding. Representatives of the company said that its bonds in the past had been sold to J. P. Morgan & Company of New York.

TRANSMISSION.

PLACERVILLE, CAL.—The Western States Gas & Electric Company is soon to begin work on a power line to Camino.

MARTINEZ, CAL.—The application of the Great Western Power Company for a blanket franchise for power lines through the county was rejected by the board.

VENTURA, CAL.—The Ojai Power Company has made application for a franchise, granting the right to construct an electric light and power system along the public highways of Ventura County. Sealed bids will be received up to October 3.

TELEPHONE AND TELEGRAPH.

SHOSHONE, IDAHO.—A force of surveyors employed by the Mountain States Telegraph & Telephone Company is running a line from Mountain Home to Shoshone.

DOUGLAS, ARIZ.—The telephone system of this city will be entirely reorganized within the very near future. The plan of the company is to use conduits to carry wires underground.

SHOEMAKER, N. M.—Work on the Ranchers' Telephone Company's lines is being rapidly pushed forward. They expect to soon connect with the standard lines, at Wagon Mound and Las Vegas.

WINNEMUCCA, NEV.—The Golconda Telephone & Power Company has applied for a franchise to erect poles and string wire thereon for a new telephone line from Winnemucca to National, via Paradise Valley.

SAN RAFAEL, CAL.—The Marconi Wireless Telegraph Company of America with offices in the Phelan Building, San Francisco, is closing a $25,000 deal in a ranch near Bolinas for a site for a wireless station. It is the intention of the company to expend about $150,000 on the plant.

WINSLOW, ARIZ.—Word has been received here that the Mountain States Telephone & Telegraph Company, which recently took over the holdings of the Overland Telephone & Telegraph Company, of this State, has sold part of its holdings to F. W. Nelson of St. Johns and Messrs. W. B. Woods and Lloyd C. Henning of Holbrook.

SEATTLE, WASH.—Notice has been served on the Pacific Telephone & Telegraph Company by the superintendent of Public Utilities of Seattle that the physical assets, conduits, etc., of the Independent Telephone Company, which was

recently acquired by the Pacific Company, must be immediately removed from the streets. The franshises of the Independent Company was repealed in July. An ordinance has been adopted which provides that the city shall take charge of all conduits of the old company occupying the streets after a specified date. If the city takes this property it is the intention to use it as a foundation for a municipal telegraph system.

LOS ANGELES, CAL.—Interchange of telephone service between the two companies operating in this city, or, in lieu of that, the consolidation of both companies, was recommended in a report of the utilities committee of the Los Angeles Realty Board, read before the members of the board at their last weekly luncheon. The board as a whole, however, refused to take any action until the members shall have had the opportunity of hearing the matter argued at more length at a later meeting. During the discussion it was pointed out by opponents to the consolidation plan, that as a result of the dual service it is now possible to get two main lines to an office for the same price that was formerly paid for one line before the Home Company came into the field, and a fear was expressed that a change would bring about lack of competition, poor service and higher rates.

SAN FRANCISCO, CAL.—A conference of officials of the Western Union Telephone Company, Pacific division, embracing California, Oregon, Washington, Nevada, Arizona and British Columbia, was held recently in San Francisco. This was one of the regular meetings frequently held by the officials of the company for the purpose of considering existing business conditions and prospects in order that extensions and improvements of the facilities and service may be arranged for accordingly. Those in attendance were Division Commercial Superintendent H. F. Dodge, San Francisco; Division Commercial Superintendent A. H. May of San Francisco, E. Boenning of Seattle, and H. McPhee of Los Angeles; Division Traffic Superintendents H. C. Chase of San Francisco, H. J. Jeffs of San Francisco, G. D. Hood of Seattle and R. H. Fuller of Los Angeles.

TRANSPORTATION.

TULARE, CAL.—A contract has been let by officials of the Big Four Electric to Hahn & Son of San Francisco for the grading of the line from Tulare to Visalia, and from this point to Porterville, a total distance of 41 miles. The contract price is $30,000.

LONG BEACH, CAL.—An ordinance has been presented to the City Council by the Board of Public Works authorizing that body to enter into a contract with the Pacific Electric to construct a trackage connecting the municipal tracks with the Salt Lake Railroad, which will give all railroads entering the city connection with the municipal docks.

SAN FRANCISCO, CAL.—The State Railroad Commission has granted the petition of Patrick Calhoun and his associates of the United Railroads Company to issue $300,000 of trunk equipment notes as part payment for 65 new cars they are to have built in the East for use in this city. The total cost of the new rolling stock will be $365,000, the company paying $65,000 in cash and the balance in the notes just authorized. The commission takes this favorable action with the understanding that Calhoun and his railroad officials will confer with a committee of the Supervisors about a design for the new cars.

WOODLAND, CAL.—The final stages of the survey of the line of the Sacramento Valley Railroad Company will be started this week from Woodland, the only strip of unsurveyed territory now being between Woodland and Denverton. A large force of men will be put to work under the direction of Melville Dozier, of the Dozier Construction Company. At Denverton the line will join the Oakland and Antioch Railroad, over whose lines an agreement gives the Sacramento Valley the right to run its trains. It is expected that the survey to Denverton will be completed within 30 days, the sale of necessary stock within six months, and that the road will be in actual operation January 1, 1915. Sacramento offices of the company have been opened in the Forum building in the charge of Dumas & Brewer.

SAN JOSE, CAL.—That the Peninsula Railroad Company is anxious to complete its electric line to Alum Rock Park as soon as possible, is indicated by the filing of a suit for the condemnation of a railroad right of way through the lands of James B. Bullitt at the mouth of Alum Rock Conyon. The new line of the Peninsula company to Alum Rock Park was completed by way of Berryessa several months ago as far as the western boundary of Bullitt's place. Construction crews have since been busy between the eastern boundary of the place and Alum Rock Park, leasing an uncompleted link on Bullitt's place. Bullitt is said to have offered the company a free right of way through the rear of his place, but this route is impracticable from an engineering standpoint. The company refused to pay the price he named for a right of way through the front of his place and between his home and the Penitencia Creek, claiming that it was too high.

SAN FRANCISCO, CAL.—The Board of Public Works has awarded the contract for furnishing and installing the electrical conductors and appurtenances for the Geary street road to the John G. Sutton Company for $60,304. This contract calls for the completing and connecting of the electric fittings of the road on the entire route, from the beach to Market and Sansome streets. Other contracts for materials needed for completing the road have been let as follows: Copper wire, John G. Sutton Company, $3187; copper wire bonds, U. S. Steel Products Company, $1510; tie rods and nuts, Payne Bolt Works, $656; tie plates, Eccles & Smith Company, $2304; redwood cross-ties, Julius Heyman Company. A recommendation has been made to the Supervisors that the latter body acquire at once the land necessary for the establishment of a loop termnus for the city line at the ocean beach. The tract needed, states the city engineer, is that bounded by Cabrillo street, the Great Highway, La Playa and a line drawn parallel to Cabrillo street and 200 feet to the north.

SAN FRANCISCO, CAL.—The attitude the State Railroad Commission will take toward public utilities which are seeking permission for their initial financing, was shown in the decision permitting the Big Four Electric Railway Company to sell 100,000 shares of capital stock of the par value of $1 each. The conditions are: First, that the stock should be sold to yield to the company not less than 80 per cent of its par value in cash; second, that no commission shall be paid except on cash actually received from the sale of stock, and that commission should not exceed 20 per cent of the par value of this stock; third, commission shall be paid on stock heretofore sold only in proportion to the amount of cash that has come in; fourth, no expenditures shall be made for road construction until all of the 100,000 shares of stock shall have been sold and not less than $50,000 in cash realized from this stock and placed at the disposal of the company. If the company is unable to realize the sum mentioned, further application may be made to the commission for relief; fifth, the company must report to the commission the sale of stock as it proceeds; sixth, the company must submit for the approval of this commission the form of all contracts for the sale of stock and for construction work involving a cost in excess of $500.

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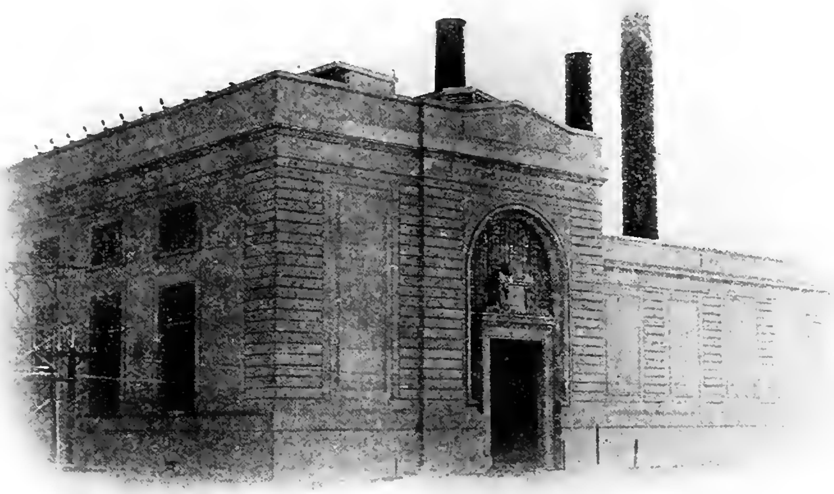


A NEW STEAM AUXILIARY AT SACRAMENTO

BY RUDOLPH W. VAN NORDEN,
Member A. I. E. E., A. S. C. E.

A re-introduction of steam generating plants to operate in conjunction with transmission systems delivering power from mountain streams across great distances to the points where the power is consumed, has been made necessary as these systems have increased in the magnitude of their business and multiplied in an endless intricacy in their transmission networks. The very type of plant which the advent of long transmission made unprofitable and for which it was discarded has been recalled on an even larger scale than of old but for quite a different form of usefulness. It is now an elaborate investment for insurance against service interruption.

The transmission of power at high voltages has attained a degree of perfection which was looked forward to, not without misgivings, less than a decade ago; that is, service interruptions are remote compared to current practice of that time. Still there remains always a possibility of unlooked for occurrences.

The business of supplying power is now so enormous and so many people are dependent on an absolutely continuous service that the auxiliary steam generating plants, at strategic points close to the center of large power markets, are well worth their cost and maintenance, even if they are called on to supply power only in rare emergencies. The auxiliary plant as now constructed is the last word in modern design and equipment and generally of a capacity to carry for a short time the entire load of the district which it serves. It is necessary that it be held ready at any moment to pick up the load and for this reason one generator is always operating on the system, that is, it is "floating," using only enough steam to supply its own inherent losses, but with sufficient boiler capacity under steam for a sudden call.

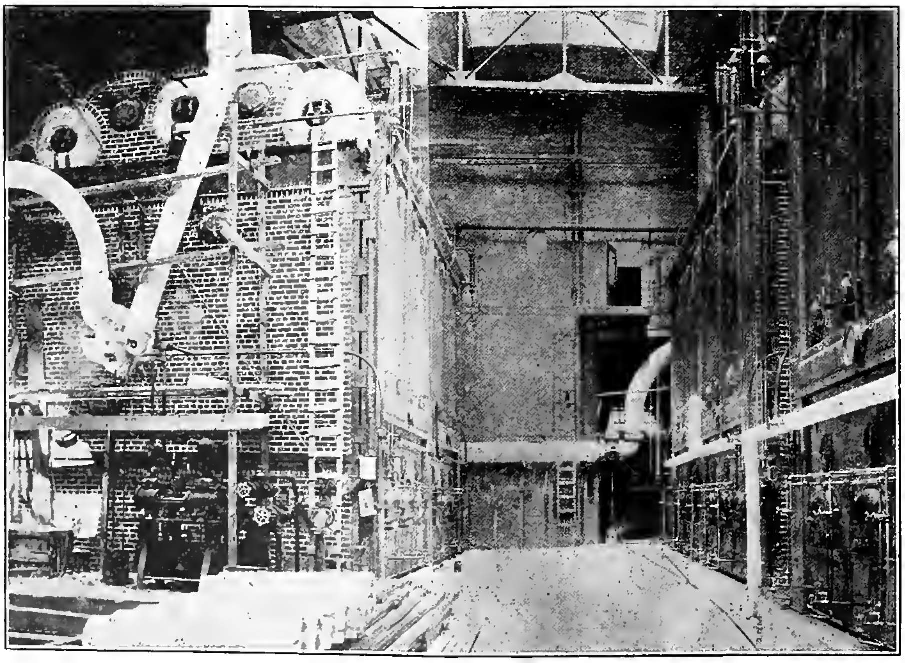
The Pacific Gas & Electric Company with its enormous network, probably the greatest in point of area covered in the world, has eleven hydroelectric plants, with at least six more not under its control with which it operates in parallel and from which it receives power. In addition to this there is now under construction a plant with generating capacity which

will amount to about 50 per cent of the aggregate power of its present hydraulic plants. In the city of San Francisco there are in regular operation great steam plants not used for auxiliary purposes, although the day may not be far distant when it will be possible to hold this machinery as a standby. All of this generating capacity amounting to 200,000 horsepower, supplies a demand which forms an enormous business. The multiplicity of plants and transmission lines is in itself a strong factor in the maintenance of continuous service at all points. But the demand for power is ever increasing and these plants are loaded to their full capacities. This condition notwithstanding the comparative safety, creates the necessity for steam driven reserve installations.

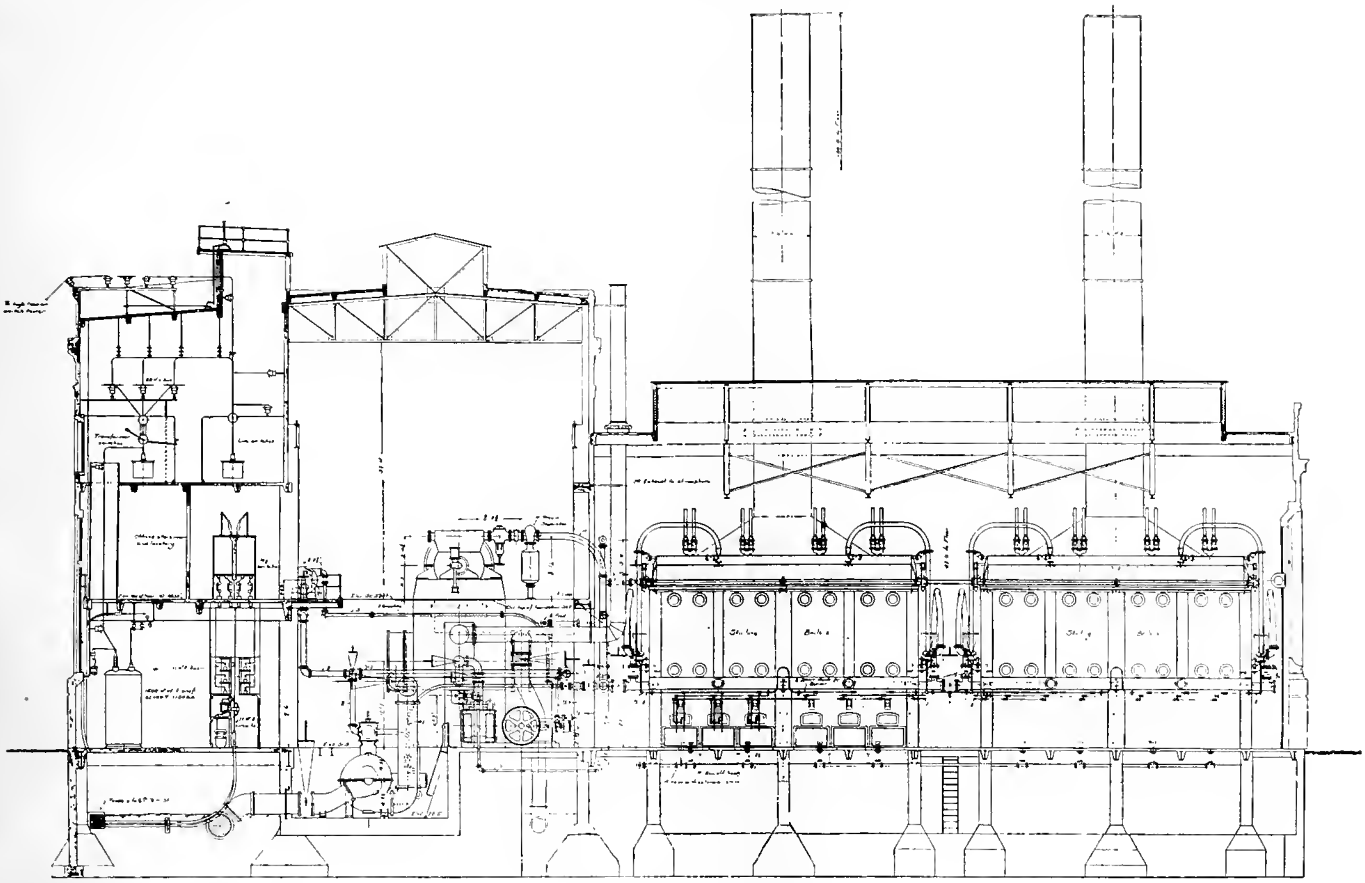
The city of Sacramento, a rapidly growing and very prosperous community, is the center of a large power market and the logical point for a steam auxiliary. This city, one of the very first in the world to be supplied with transmitted power generated by water, one of the first to put the steam central station out of business as an obsolete curiosity, can now boast of a steam generating plant, which for its careful design, splendid equipment and pleasing finish is undoubtedly an example of the best modern practice for the purpose which it is intended.

The plant is situated within the city limits about a quarter of a mile north of the city itself and near the east bank of the Sacramento river. The city is growing rapidly and some day it will surround the plant, or, what is quite probable, a great public park will adjoin it, for the present setting of green fields and river bottom foliage are picturesque in the extreme. At any rate the company has wisely looked into the future and this plant will be an ornament to any community, or even a park. Power plants, especially steam power plants, are often classed in the public mind with mill-hoists, tanneries or boiler shops, and, while there are many notable examples of elaborately designed and executed power plant buildings, care in this regard is by no means always taken. Engineers are coming more and more to the realization that there is greater meaning to the neat appearance and pleasing outline of their plant buildings than the mere esthetic desire for ornamentation. The psychological effect on those who are directly associated with its operation, upon the minds of the public with whom the business of the plant comes in close touch, and upon utilitarian values in the community immediately adjacent is of the greatest importance.

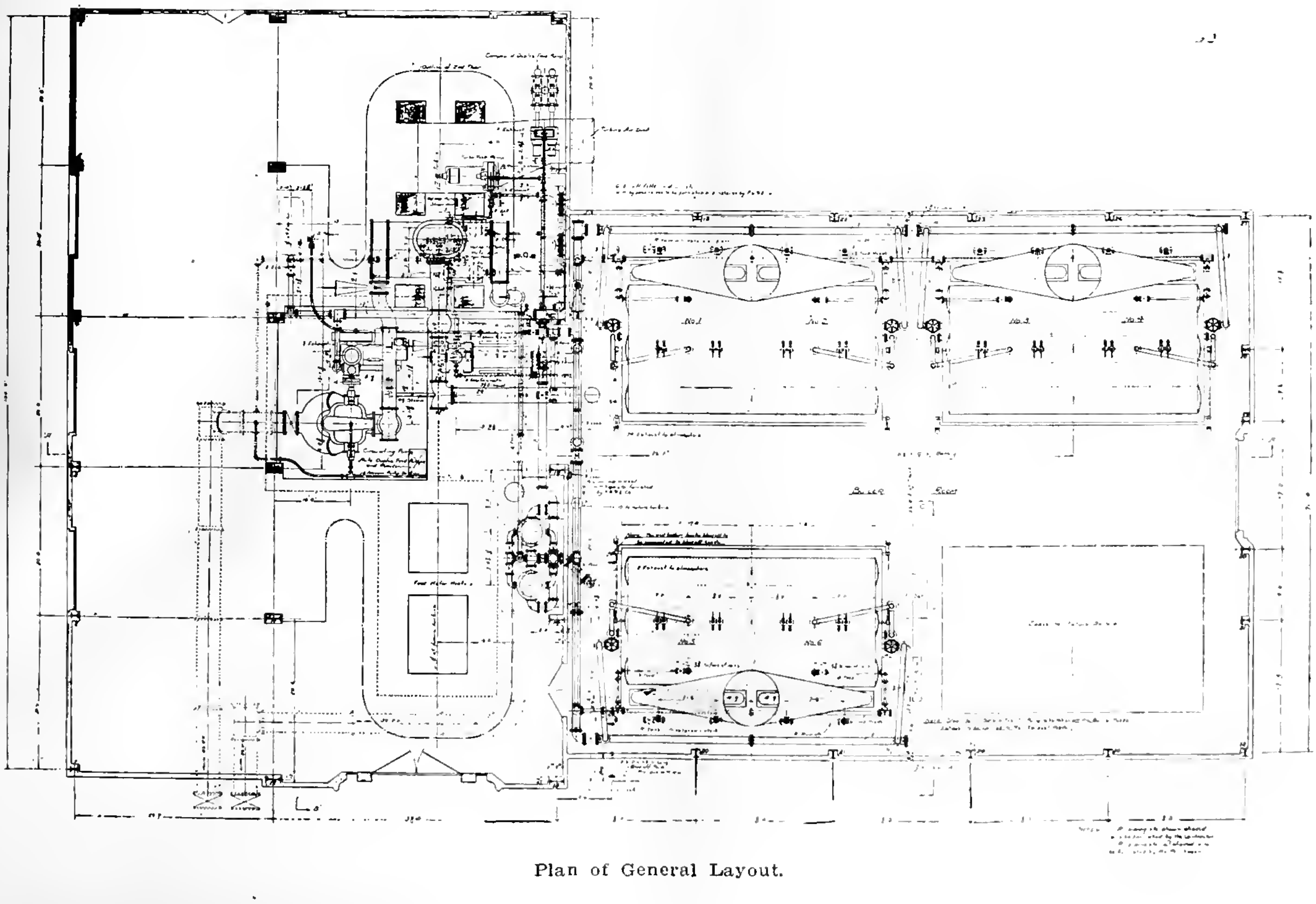
The plant building has a steel frame with Howe roof trusses. It is supported on piles as there is no rock near the surface at this point. Under each column is a block of concrete containing 12 cubic yards which in turn is supported on a cluster of piles. In all 500 piles were used. The walls are of reinforced concrete and are 6 in. thick. The roofs are almost flat and there are monitors over both the boiler room and the generating room bay. The roofs are also of reinforced concrete. The building is in two rectangles, forming an "L." It has a total length of 156 ft. 5 in., a width at the northern end of 100 ft. 6 in., and at the other end of 71 ft. 4 in. The exterior design was furnished by Mr. Willis Polk, an architect in San Francisco. It was the purpose to obtain, with the utmost simplicity, and at cost but a trifle more than the roughest finish, a building which for its classic outline and dignified appearance, would never mar the surrounding landscape, but be a pleasure to look upon. In accomplishing this end, a simple classic design was adopted. The blank walls were paneled in the final plaster coat, symmetry of outline being derived by correct balance with the general structure. The main entrance is heavily moulded and the ornamental arch and cartouche is the only part where any really elaborate finish has been attempted. A cream tinted Santa Cruz white cement plaster finish carefully laid carries out the effect desired and, were it not for the three smokestacks the building



View in Boiler Room, Showing Steam and Oil Piping; Fuel Oil Pumps to Left; Door to Generating Room in Background.



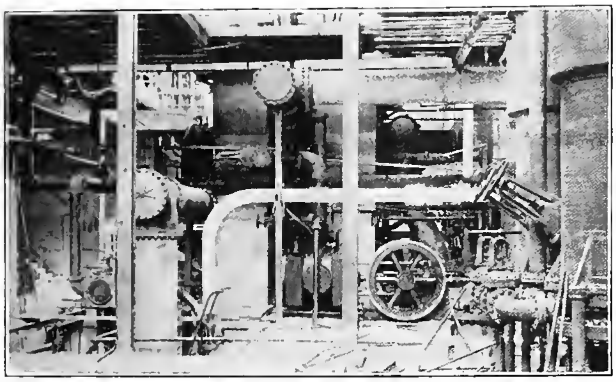
Cross-Sectional Elevation of Plant.



Plan of General Layout.

might be easily mistaken for a gallery of fine arts. At any rate the people of Sacramento have something to be proud of, from the rare beauty of it.

As before stated the interior is in two sections. The boilers occupy the more southerly of these compartments. They are ranged on either side of a center aisle which runs lengthwise of the building toward the generating room. On the east side are



Auxiliary Apparatus on Main Floor. Feed Water Heaters on Extreme Right; Mullen Vacuum Pump in Center; Engine Driven Circulating Pump in Pit at Left; Condenser Behind Concrete Columns in Background.

four Stirling boilers in two batteries, each boiler having three firing doors. On the west side there is space for an equal number but for the present, one battery only will be installed. These boilers are of the water tube type and each contains 600, 3¼ in. steel tubes, three 42 in. drums and one 18 in. mud drum. Each has a capacity of 846 boiler horsepower or a total of 5000 boiler horsepower.

In the general set-up and firing arrangements, modern practice is followed, and in the piping the installation is unique and shows a careful study for modern conditions. Steam is taken from the top of the boiler or steam drum and led through a 10 in. pipe which describes a half-circle, to a point about half-way to the floor, in the space outside the brick wall of the battery. Here is a connection to the superheater, a valve and safety valve. From the valve, connection is made to the header-pipe through a 10-in. pipe formed in a half-circle. Plenty of space has been given between the boiler casings and the walls of the building so that free access may be had to any part of the header. Contrary to ordinary practice the header, which is a 14 in. pipe, is supported on heavy steel brackets which are bolted to the steel frame of the building, at a distance from the floor of only 9 ft. This adds greatly to the ease of access to this header for inspection or repair. The two headers are connected together by a cross header at the northern end of the boiler room. This must necessarily pass the opening in the wall between the boiler and generating rooms and in order not to interfere with the clearance of this opening, it is curved in a semi-circle over the opening. This curve also acts to equalize any expansion in the cross header.

All of the main high pressure steam piping is of wrought steel and is extra heavy hydraulic pipe; it is designed throughout for operation with 200 lb. steam pressure and 150 degrees of superheat. This equipment was supplied by the Pittsburg Piping & Equipment Company. Cast steel valves, fittings and flanges are used for all sizes from two inches and larger. The boilers are equipped with Hughson automatic stop and check valves and the remaining valves in the piping system were supplied by Crane & Company. The high pressure pipe flanges where the sizes are four-inch and larger have the "Pittsburg joint," this being an improvement on the well-known Van Stone joint which is made by rolling the end of the pipe over the flange so that the rolled-over ends form the joint and the flanges are used only for the purpose of clamping the joint. In the Pittsburg joint the face of the flange is beveled where it is covered by the lap of the pipe to allow for the difference in thickness of the pipe where it has been thinned by rolling. This insures the full thickness of the pipe where the strength is needed. In addition the inside of the flange is also beveled toward the face so that the pipe is flared out at an angle of 10 degrees before the end is rolled over the face of the flange. Eclipse steam traps made by the Hughson Steam Specialty Company are used. The outlets from the main steam header and elsewhere wherever possible are made by welding wrought steel nozzles to the pipe which eliminates fittings and reduces the number of joints which would otherwise have to be used. Before connecting to the headers, the pipe from each boiler is supplied with a valve. At the center point of the header on the east side there is installed a valve whereby one-half of this header may be shut-off and there are two valves in the cross header at either end of the curved section.

When the fourth battery of boilers is installed the headers will be connected across the south end of the boiler room, thus forming a closed loop. This with the necessary valves will make a perfectly flexible system of steam distribution and enable the cutting out of any section for examination or repair without interruption to service.

There is one steel smokestack for each battery of boilers and these are mounted directly over the respective sets. The fourth smokestack is not in place as its boiler set will not be at present installed. The smokestacks are 7 ft. 6 in. in diameter and project above the boiler house roof 60 ft., or 100 ft. above the furnace floor.

Fuel oil is delivered under the boilers through Peabody back-shot burners. Worthington steam pumps deliver the oil to the burners, from one or both of the service tanks, the flow from the tanks to the pumps being actuated by suction of the pump.

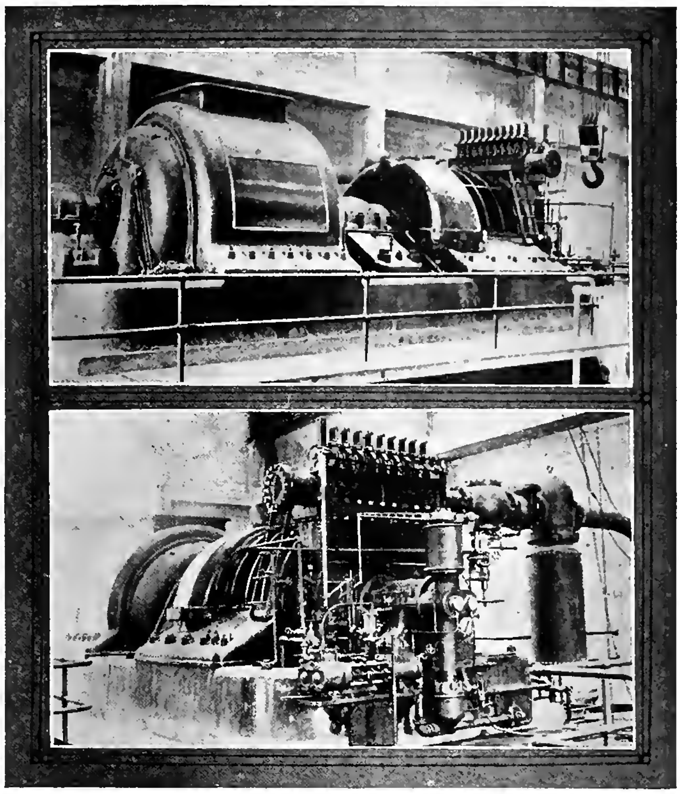
Generating Room.

The remainder of the building is occupied by the generating and auxiliary machinery and the transformers and electrical equipment. The former apparatus is placed in the bay which adjoins the boiler room and extends across the building. The main arched front entrance of the building opens directly into this bay, which has a width of 38 ft., a length of 100 ft., and a clear height to the roof of 52 ft. An electrically driven traveling crane with a capacity of 80,000 lb., supplied by the Cyclops Iron Works of

San Francisco, operates throughout the length of the bay, the rails on which it runs being supported on girders which are carried by the steel columns in the partition with the boiler room on one side and the transverse row of columns which also support the second and third floor galleries, on the other.

Provision has been made in the design of this plant for two main steam generating units, one of which is now installed. These units will rest near the east and west end of the bay and about midway on the floor space. The turbo-generators will be mounted on heavy concrete piers which resemble a table having four legs and are on a level with the second or switch-board floor. The first turbo-generator, which is already installed is a Curtis, horizontal type, five-stage unit. In this turbine, steam is admitted through a series of valves which are automatically operated by the governor and open or close in sequence as the demand for power increases or decreases. The steam is led into the first stage through a series of nozzles in which it is expanded, whereby velocity is gained. This energy is given to the vanes of a series of rotating elements as it passes through them. A second expansion takes place through a second set of nozzles and the next set of vanes receive energy. This performance is repeated until five stages are passed when the steam exhausts at low pressure into the condenser, where the water of condensation is returned into the boiler feed. Directly underneath the turbine and suspended between the legs of the concrete foundation is the condenser. This is of the surface type furnished by the C. H. Wheeler Company and consists of a large steel drum in which are fixed 3000 one-inch brass tubes, giving a cooling surface of 10,000 sq. ft. On the main floor under the condenser are placed two 4 in. hot-well pumps. One of these is driven at 1500 r.p.m. by a Kerr steam turbine, while the other is driven by a 20 h.p., 110 volt direct current interpole motor. Near these sets is a 4 stage, 4 in. Alberger rotary pump direct connected to and driven by an Alberger-Curtis steam turbine operating at 3600 r.p.m. This unit will be in continuous use to supply the feed water to the boilers. There is also a Dow duplex steam pump with cylinders 9x16x7x12 in. for a like purpose, but as the efficiency of this type of apparatus is lower than the turbo-pump, it is to be used as an auxiliary or emergency boiler supply. Near these sets are two Elliott feed water filters. On the opposite side of the turbine foundation there is placed a Mullin, wet-vacuum air-pump, also supplied by the C. H. Wheeler Company. This pump has cylinders 9x16x7x12 in.

Between the turbo-generator piers and placed in a pit, somewhat below the main station floor is a circulating pump. This draws water from the river through a 30 in. cast iron pipe and forces it through the condenser, where by the cooling effect, causes condensation of the exhaust steam. The water with the heat extracted from the steam passes back to the river through a pipe similar to the intake. This unit consists of a 30 in. double feed Byron Jackson centrifugal pump, driven through a flexible leather-link coupling by a quarter-connected American-Ball compound engine. In this engine the high-pressure cylinder is horizontal while the low-pressure is vertical. In connection with this set is a three-throw Byron Jackson plunger vacuum pump for starting and maintaining the suction for the larger centrifugal pump. It is driven at 150 r.p.m. by a 5 h.p. induction motor through gearing.



Main Turbo-Generator Showing Governor Valves, Throttle Valve and Oil Pump.

Connection between the steam header in the boiler room to the turbine is made through a 10 in. pipe which raises from the header, curves in a quarter circle, passing through an opening in the dividing wall to the main steam valve on the turbine.

The above apparatus is standard and similar to that used in many modern stations, but the arrangement is at once simple and get-at-able and the workmanship, particularly on piping, is especially good. Pipes and all surfaces where radiation of heat is undesirable have a magnesia heat insulating covering 3 in. thick.

Boiler feed water and circulating water for use in the condensers is taken from the Sacramento river. A well has been put down to supply water for the boilers in the event that the river water should become too muddy for use.

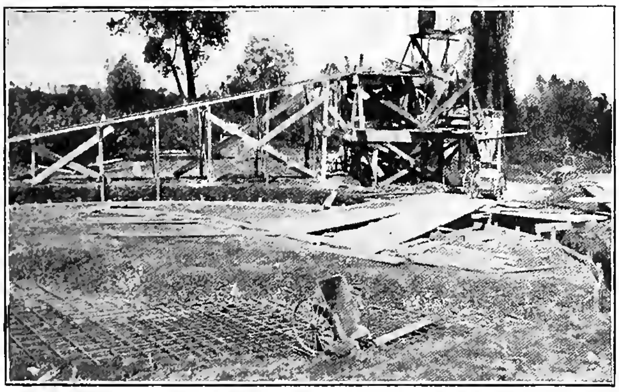
The intake from the river is unusual. The Sacramento is contained between levees and at periods of high water the surface is nearly on a level with the floor of the plant, while at low water the surface may be 20 ft. lower.

A pier of piling was erected extending from the levee well into the river. The upstream side was slanted to the current and planked so that floating material would be deflected away from the pier. The 30 in. cast iron intake and discharge pipes are carried

underground from the pump pit in the station, through the levee and suspended within the pier. The intake pipe terminates in a flange and head. Extending some distance back the surface of the pipe was turned and to it is fitted a revolving sleeve which carries a "T" outlet. Normally this outlet pipe hangs vertically and at its lower end are a strainer and foot-valve. With the aid of a block and tackle erected on the pier, this intake may be revolved into an upright position for cleaning and inspection. The discharge pipe turns down through a cast iron elbow to a point below lowest water, and then by means of another elbow the opening is made horizontal. The outlet opening is downstream from the intake so that there will be no possibility of the hot discharge getting into the intake.

Oil Supply System.

Fuel oil may be delivered to the plant either by barges coming up the river, or from cars. The former discharge at the pier, the oil being pumped through an 8 in. wrought iron pipe to the storage tanks. There are provided six vertical pipe outlets with valves placed in a line parallel with the railroad track into which oil from cars may be delivered.



Reinforced Concrete Pad for Support of Oil Storage Tank, Under Construction.

The storage tanks are placed in the rear of the power house a distance of 450 ft. Each tank has a capacity of 10,000 bbl. and together they will operate the plant continuously for one month. These tanks are of riveted sheet steel and are 49 ft. 3 in. in diameter and are 30 ft. high. They are mounted on heavy reinforced concrete pads, which extend beyond the sides of the tank walls. Surrounding each tank is a reinforced concrete wall 12 ft. high. This base and wall form an external tank and is for the purpose of holding the oil, should the steel tank fail or the oil get on fire, the capacity of the concrete container being equal to that of the steel tank. There is a waste drain whereby the oil may be carried away in case of disaster.

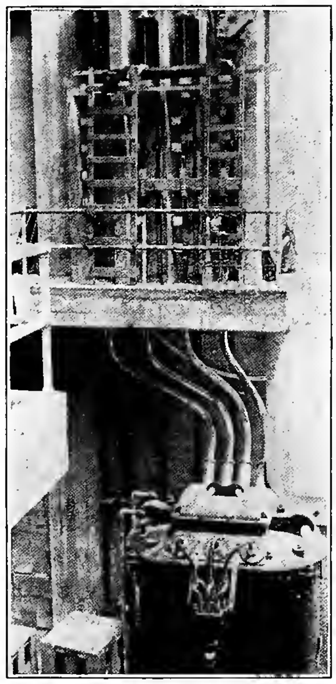
Oil from the tanks is brought to the building through duplicate 8 in. wrought iron pipes. Laid with these pipes is a 2 in. pipe carrying live steam or exhaust for the purpose of heating the oil as it flows from the tanks to the boiler room, and these pipes are all enclosed in a box which is packed with sawdust

There are two rectangular service oil tanks mounted on concrete bases immediately south of the boiler room. These have a capacity of 200 bbl. each.

Pointers are mounted on the wall within the boiler room back of each tank to indicate on brass gauges the quantity of oil within the tanks. By measuring the surface height of oil in a small tank, a much higher degree of accuracy may be obtained than if the measurements were made in the storage tanks.

Electrical Equipment.

The transformer and switch equipment is placed on three floors, including the main station floor, and occupies the space between the engine room bay and the north wall of the building. There are six 1500 kilowatt General Electric transformers, placed in a row close to the north wall on the main floor, these are oil-immersed and water cooled and are wound for a voltage ratio of 31,215-54,000 Y on the high tension side and 11,250-19,500 Y on the low tension side. The



Three-Phase Generator Transformer and Reactance, Showing Brass Tube Conduits.

high tension wiring is supported on 4 part insulators mounted on pipe framework. There is space for three additional transformers.

Directly in front of the transformers and arranged in a row are the two 11,000 volt station bus lines, meter transformers and disconnectors. These are mounted in 3 in. concrete compartments, the busses being arranged vertically, front and back and the various transformers underneath.

In one corner are placed three 100 kw. service transformers for lighting and power in and about the station.

On the main floor at the east end of the generating bay is a three-phase, 5000 kw. oil immersed and water cooled transformer which serves the double purpose of a reactance in the generator circuit and also to transform from the 4000 volt generator current to 11,000 volts for paralleling into the bus lines. It is necessary to obviate the damage which would be caused by the flow of excessive current in the generator circuit in case of a short circuit, to interpose

The Switchboard. Turbo-Exciter on Right.

General View of Switchboard Gallery. Switchboard on Left; Switch Cells in Rear; Turbo-Exciter in Right Foreground.

a reactance. The cost of this reactance and the extra cost of a generator wound for 11,000 volts, overbalances the cost of a raising transformer designed to take the place of a reactance coil. The leads to this transformer are brought from above through 3 in. brass ducts. In this particular instance, the construction which is exposed and noticeable has been done in an exceptionally neat and artistic manner.

Communication between the main and upper floors is had by a wide steel and concrete staircase placed within the northeast corner of the building.

The second or switchboard floor is on a level with the base of the turbo-generator, it is carried beyond the columns into the bay and is continued across the bay and around the turbo-unit as a steel plate structure mounted on light steel framework supported from below on steel columns.

The exciters are placed on this floor occupying spaces between the building columns at either end of the switchboard. The exciter set at the right of the switchboard consists of a six-pole interpole 75 kw. 125 volt, direct current generator, driven at 3300 r.p.m. by a Curtis non-condensing steam turbine using steam at 175 lb. pressure. The other exciter unit is a 100 kw. interpole direct current, 125 volt generator driven through a rigid coupling by a Fort Wayne 150 h.p. 3-phase, 220 volt, induction motor, at a speed of 870 r.p.m. This unit has but three bearings, two on the motor and an outboard bearing on the generator and is mounted on a cast iron base.

The switchboard has the form of the arc of a circle and is placed well out in the bay and between the two main generating units. The curved form is adopted for two purposes; the first, giving ample space in the rear of the end panels which would otherwise be obstructed by the building columns, while the second allows the operator to observe the instruments on all of the panels more easily without changing position and also makes observation at a distance easier.

There are nine ebony asbestos-lumber panels composing the switchboard and these control the two main generators, the exciters, four high tension circuits, and two local circuits. The instruments are General Electric and Westinghouse round type and the switch control all of the remote type for motor operation.

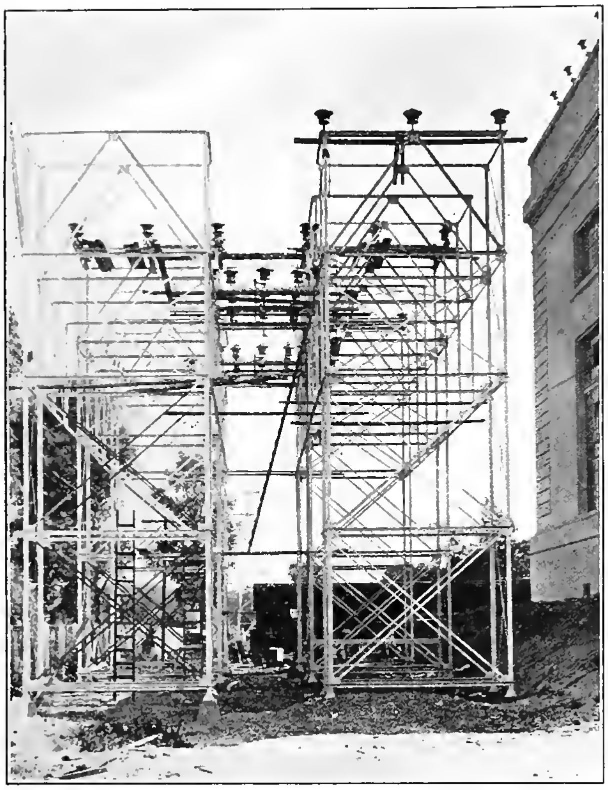
Facing the switchboard, and placed against the south wall of the generating room is a triangular board supporting steam, first stage pressure, and vacuum gauges and an electric (voltmeter type) speed indicator. On either side of this board are two Hohman & Mauer mercury columns for accurate vacuum measurements.

In the rear of the switchboard, arranged in two rows of 12 each, their cells being back to back, are the 11,000 volt, type H-3 General Electric, motor-operated circuit-breakers. This arrangement in two rows make possible duplicate sets with connection from below to the two bus lines, and these pairs control the circuits from the two turbines, three sets of transformers, six feeder circuits and a house circuit. At the east end of this floor or gallery, is a concrete switch cell containing two 4000 volt three-pole type H-3 circuit breakers on the main generator leads and near these is a compartment directly over the compensator transformer, containing disconnectors and series and shunt transformers for supplying the generator switchboard instruments.

To the rear of the 11,000 volt switch cells and extending across the north end of the building are a series of rooms containing a lavatory and shower bath, a locker room, store room, foreman's office, etc.

The third floor is not open to the generator bay. This floor contains the 60,000 volt oil circuit breakers. These are of the horizontal four-break type manufactured by this company. Each set of three switches is mounted on the floor and has its own concrete cell. There are 6 sets and they are arranged in two rows along the north and south wall of the room. The three high tension circuits from their respective circuit-breakers to the transformers on the first floor are led down through the rooms on the second floor gal-

Rotary, 60,000 Volt Disconnecting Switches on Roof and Double Windows for Entrance of High Tension Lines.



Structure for Receiving Four Transmission Lines With Sectionalizing Disconnecting Switches. Transmission Tower in Background.

lery in reinforced concrete tubes, having a clear inside diameter of 3 ft. These tubes, 9 in all, are built of expanded sheet metal and are plastered inside and out with cement plaster until they have a thickness of 3 in. At their upper ends they extend 2 ft. above the switch-room floor to prevent the possibility of oil from the circuit-breakers which may have leaked onto the floor from running down the tubes.

A high-tension bus is supported from the roof on suspension type insulators, and has disconnectors at the center point.

The outgoing (or incoming) 60,000 volt lines are brought from their circuit-breakers through bar disconnectors into a closed monitor which rises above the roof and from this the lines pass horizontally through circular openings 6 in. in diameter in double glass windows, the sashes of which are 3 ft. x 4 ft., to Baum type, horizontal, two-break, rotary disconnecting switches, mounted on steel structural framework which in turn is fastened to the roof.

A somewhat intricate high tension switching arrangement is made necessary at this plant. There are converging at this point, three transmission lines from three of the hydroelectric generating plants of the system, Colgate, Alta and Folsom, and a fourth line which is a tie-line to the main transmission between Colgate and Oakland at Davis. As all of these points named except Folsom, are connected through other lines in the network, the number of combinations, either in distributing the load or in the supply in case of emergency are considerable, while the Sacramento supply at all times is controlled through this station.

For the present the local distributing station in Sacramento for railway, light, local power and street service will be maintained, the new plant acting only as a reserve steam station and a sectionalizing point for high tension switching.

COST OF CONCRETE LININGS FOR CANALS.

BY B. A. ETCHEVERRY.[1]

All irrigators are well acquainted with the fact that the losses in conveying water in earth canals are in many cases very large and with newly excavated canals are often so great that it is difficult to deliver water at the lower end. On irrigation systems with unlined canals these losses usually range from 25 to 60 per cent of the water diverted and taken in the canal system, and there are many instances where the losses are much greater. In two miles of canal of the Canyon Creek Irrigation Company, near Kelowna, the losses amounted to 60 per cent of the water entering the canal. This is not an exceptional case for in some California canals losses of 64 per cent per mile have been observed. It is safe to state that on an irrigation system consisting of earth ditches, only 50 per cent of the water diverted is delivered to the fields.

Extent of Seepage Losses in Canals.

The extent of seepage losses depends on many factors such as porosity of the soil, the form of cross section, the size of the canal, the number of seasons the canal has been operated, the amount of silt in the water, the velocity of flow, the depth to the water table, etc.

The most valuable general observations as regards the amount of these losses are those of the Irrigation Investigations Office of the United States Department of Agriculture. From series of measurements on seventy-three ditches in the Western states, they have found that the average loss per mile of ditch is 5.77 per cent of the entire flow; the measurements range from a maximum of 64 per cent per mile to a slight gain in a few cases. Large canals in general lose less in proportion than small ones. The measurements show that the loss per mile averages about 1 per cent for canals carrying 100 cu. ft. per second or more, about 2½ per cent for canals carrying 50 to 100 cu. ft. per second, 4½ per cent for canals carrying 25 to 50 cu. ft. per second, and 11¼ per cent for canals carrying less than 25 cu. ft. per second.

For some purposes it is preferable to know the extent of seepage expressed in cu. ft. of water per day per sq. ft. of wetted area of the canal. This is equivalent to stating the depth of water in feet lost each day. A number of measurements have been made in various parts of the country and some of these have been assembled by F. W. Hanna, project engineer of Boise U. S. Reclamation Service Project, in Idaho, who states that from careful consideration of the data assembled, it would appear that a seepage loss of 0.5, 1 and 1.5 cu. ft. per sq. ft. wetted surface per day might be assumed for canal losses respectively for rather impervious, mediumly pervious and rather pervious soils. Based on the above figures and assuming a common form of cross section, he obtains the following results as the seepage loss per mile expressed as per cent of flow.

[1]Head of Department of Irrigation, University of California

Capacity of canal. Cubic feet per sec.	Loss in per cent. of flow per mile. For rather impervious soil.	Mediumly pervious soil.	Rather pervious soil.
10 or less	4	8	12
11 to 25	2.5	4.5	7
26 to 50	1.5	3.	4.5
51 to 75	1.	2.	3.
76 to 100	.75	1.5	2.5

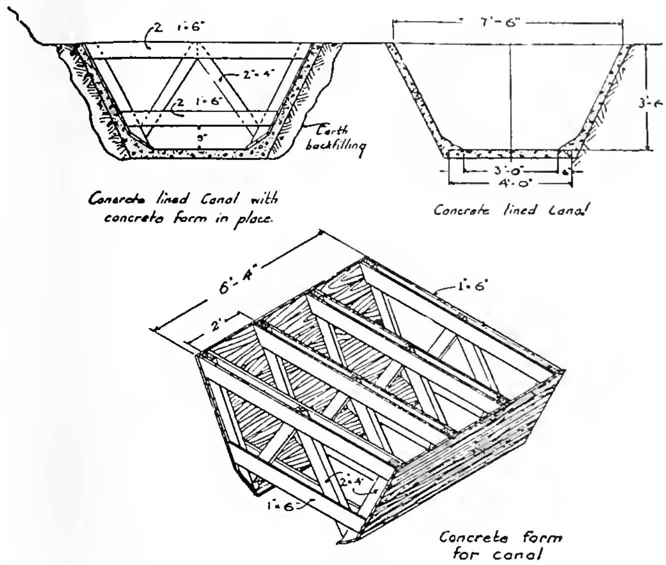
The above table gives results which agree with those obtained by the Irrigation Investigations Office as closely as can be expected because of the numerous factors involved.

Evaporation Loss from Water Surface of Canals.

The losses above stated include seepage and evaporation, but contrary to general belief, the losses of evaporation from flowing water in a canal are insignificant when compared with those of seepage. It has been shown that the losses of seepage and evaporation per day might be assumed at 0.5, 1 and 1.5 cu. ft. of water per sq. ft. of wetted surface respectively for rather impervious mediumly pervious and rather pervious soil. These are equivalent to losses of water 6, 12 and 18 in. deep. As compared to these figures, the evaporation from water surface for the irrigation season will generally be about ¼ of on in. per day, which is from 25 to 75 times less than the above seepage losses. Seepage and evaporation measurements made at Twin Falls, Idaho, and reported by Elias Nelson (Bulletin 58, University of Idaho) show that the evaporation ranged from less than 1 per cent to less than 2 per cent of the total loss in the canals. On one of the largest systems in the San Joaquin Valley, California, the total length of canals is 165 miles and the total seepage loss was 28 per cent and 30 times greater than the evaporation loss. These and other numerous experiments show that the evaporation losses in the conveyance of water are so small as compared with the seepage losses that they are of no importance.

Concrete Linings.

The earliest use of concrete linings was in southern California about 1880 when the increasing value of water made it necessary to do away with losses. Since that time practically all of their canals, which are comparatively small, carrying less than 100 cu. ft. per second, have been lined with concrete and in some cases replaced with concrete pipes. Until recently very little concrete lining had been done outside of that region, but during the last few years concrete lined canals have been constructed on many of the projects of the United States Reclamation Service and on numerous private projects. There are now several examples in California, Oregon, Nevada, Washington, Idaho and other states and during the past two years some excellent work has been done in British Columbia. The Fruitlands Irrigation and Power Company near Kamloops has lined about 6 miles of its main canal which averages 3½ ft. in depth, 4 ft. wide at the bottom and 7½ ft. wide at the top, with an average thickness of concrete of 3 in. and when the system is completed there will be about 15 miles of concrete lined canal. The Kelowna Company has lined the upper 5 miles of its main canal, 2½ ft. deep, 3 ft. wide at the bottom, and 5½ ft. wide at the top, with 3 in. of concrete. The remaining 7 miles of the canal, which is 1.5 ft. deep, 2 ft. wide at the bottom and 4½ ft. wide at the top, is lined with 2 in. of concrete.



METHOD OF CONCRETE LINING CANALS WITH FORMS AS USED BY FRUITLANDS IRRIGATION AND POWER CO., LTD

Effect of Frost.

Frost should have no effect on the lining if the soil is well drained. But when the soil contains water, freezing will produce heaving of the soil which will not be resisted even by thicker linings than those recommended. Usually a canal which must be lined is located where the water drains too readily from the soil but if the canal is located where water is liable to collect behind the lining, a drain should be provided. The drain should be a 3 or 4 in. tile placed below the floor of the canal lining in a trench 12 in. deep, located along the center line of the canal and the tile covered preferably with loose rock gravel, sand, or other porous material. To discharge the water collected cross drains should be placed every 400 or 500 ft. or wherever there is a drainage channel. The tile may be omitted and the trench filled entirely with rock or gravel but this is not as efficient.

Cost of Concrete Linings.

The cost of concrete lining varies a great deal with the accessibility of the canal the material through which the canal is cut, the planning of the work, the efficiency of the construction force, the price of labor and material.

The cost of lining with forms is given by the following examples:

The Anaheim Union Water Company of Southern California, which has many miles of concrete lined canal, obtained the following unit cost for 1000 ft. of a canal 9 ft. wide at the top, 6 ft. wide at the bottom and 3 ft. deep, lined with average thickness of concrete of about 3 to 3½ in., with the corner at the bottom made thicker.

Material	Cost per 1000 feet.
170 barrels of cement at $2.70	$ 460.00
170 cubic yards of gravel at 65c	110.00
Labor of backfilling using earth form	254.00
Labor of placing with concrete form	212.00
	$1,036.00

Cost per lineal foot, including backfilling, $1.036.
Cost per square foot, including backfilling, $0.0818.

For 4070 ft. of a smaller canal 2½ ft. wide at the top 1 ft. wide at the bottom and 1½ feet deep, lined with 2 in. thickness of concrete, the cost was:

Material.	Total cost for 4070 feet.
180 barrels of cement at $2.40	$ 432.00
180 cubic yards of gravel at $1.25	225.00
Total labor for backfilling, mixing and placing concrete	270.06
	$ 927.06

Cost per lineal foot, including backfilling, $0.228.
Cost per square foot, including backfilling, $0.0526.

The wages paid were:

$1.75 per day for men using earth form and backfilling.

$2.00 per day for men mixing and placing concrete.

$3.00 per day for foreman.

These costs include only the cost of materials in the concrete and the labor but do not include cost of engineering, depreciation and interest on cost of forms and plant. These items would be small for the work was done under the supervision of the superintendent of the company who is paid largely for other duties, and the cost of forms and plant was small. The wages and cost of cement are low and the canal was easily accessible, making the cost of lining lower than could be obtained in British Columbia.

On the system of the Fruitlands Irrigation & Power Company, near Kamloops, the cost of lining 12,000 ft. of canal 4 ft. wide at the bottom, 3½ ft. deep, and 7½ ft. wide at the top with 3 in. of concrete averaged as follows:

Hauling forms, placing forms, backfilling with earth forms	$ .18 per lineal foot
Cost of cement	.50 per lineal foot
Cost of sand and gravel	.16 per lineal foot
Cost of placing concrete forms, mixing and placing concrete	.30 per lineal foot
Gasoline for concrete mixers	.01 per lineal foot
	$1.25

Cost per lineal foot, including backfilling, $1.25.
Cost per square foot, including backfilling, $0.105.

The concrete used was a mixture of 1 part of cement to 3 of sand and 4 of gravel. The cement cost $3.40 delivered on the job. The above cost was obtained where the canal was easily accessible along the foothills and the forms and concrete mixer could be easily moved along the banks of the canal. The cost of engineering ,administration, interest and depreciation on cost of plant are not included in the cost.

On several thousand feet of canal where the canal was excavated on a steep rocky side hill, it was very difficult to deliver the concrete and the total cost of the above items was $1.72 per lineal foot or 14½ cents per sq. ft.

On the system of the Kelowna Irrigation Company, which has about 12 miles of lined canal, no separate form was used for backfilling the earth; instead metal plates were held away from the concrete forms by studding of the thickness of the concrete inserted between concrete forms and the plate as described above. The cost of lining 24,000 ft. of main canal, 3 ft. wide at the bottom, 2½ ft. deep, and 5½ ft. wide at the top gave the following average cost:

Making rock drain below floor, hauling forms, placing forms and backfilling	$ .21 per lineal foot
Cost of cement and hydrated lime	.47 per lineal foot
Cost of sand and crushed rock	.16 per lineal foot
Mixing and placing concrete	.49 per lineal foot
Miscellaneous	.03 per lineal foot
Cost per lineal foot	$1.36
Cost per square foot	.158

The concrete was a mixture of 1 part of cement to 3 of sand and 5 of crushed rock. Cement cost $3.20 to $4.10 delivered. The wages were $2.75 per day of 10 hours for common labor and $3.50 to $5.00 for skilled labor. The cost of engineering, which included location of the canal and the cost of depreciation and superintendence, brought the total cost to 17.73 cents per sq. ft. As the cost of lining only is considered here the cost of location should not be added. The higher cost per sq. ft. obtained in this case was due to the higher cost of cement, the necessity for building roads to deliver material and move forms and mixer along the canal and to the placing of a rock drain under the floor of the canal. It was also necessary to rush the work and this probably increased the cost.

Cost of Lining Without Forms.

The main canal on the Gage Canal system near Riverside, California, has a bottom width which varies from 5 to 10 ft. and a depth from 3½ to 4 ft. and side slopes of 1 to 1. The contract cost for trimming the canal and placing the lining of cement mortar ¾ to 1 in. thick was from 3¾ to 4 cents per sq. ft. This work, however, was done many years ago when labor was cheaper.

The Burbank Power & Water Company of Washington has recently lined 4,100 ft. of the main canal which has a bottom width of 6 ft. 6 in., a depth of 2½ ft. and a top width of 14 ft. The lining is 2½ in. thick for the bottom and 3 in. thick for the sides. At the top of the sides the lining extends horizontally for 6 in. to form a coping. The concrete was mixed in the proportion of 1 part of cement to 2 of sand and 4 of gravel. The lining was finished by painting with a thin mixture of 1 part of cement to 1 of sand. The contract price was $12.50 a cu. yd. or about 11½ cents a sq. ft.

The U. S. Reclamation Service has lined 6 miles of the Main South Side Canal on the Boise Project in Idaho, with a concrete lining 4 in. thick. The canal is 40 ft. wide at the bottom, 8 ft. deep and 64 ft. wide at the top. The concrete mixture was 1 part of cement to 3 of sand and 6 of gravel. A finishing coat of cement mortar was floated over the concrete to give it a smooth surface. The work was done at a cost of a little less than 10 cents a sq. ft. excluding the cost of preparing the foundation.

These and many other examples show that for either method of construction and with average conditions and average prices, a concrete lining 3 in. thick would cost from 10 to 15 cents, including cost of backfilling or trimming the ditch to prepare it for the concrete lining and all cost of engineering, depreciation and interest on the equipment necessary for the work. A concrete lining 2 in. thick should cost from 7 to 12 cents. The lower cost in each case should be obtained with very favorable conditions.

THE JUSTIFICATION OF A RATE.[1]

BY D. C. BARNES.

In order to be justifiable, a rate must conform to the fundamental principle underlying rate making for public utilities which is expressed in the following decision, Smyth vs. Ames, 169 U. S. 546: "What the company is entitled to ask is a fair return upon the value of that which it employs for the public convenience. On the other hand, what the public is entitled to demand is that no more be exacted from it * * * * than the services required by it are reasonably worth." Many scientific rates have been devised for this purpose, which are unnecessarily complicated, involving expensive records and bookkeeping, but which on analysis do not accomplish the accurate assessment of costs for which they are designed, and have in addition the disadvantage of being so involved that the public cannot understand them and hence regard them with suspicion. Rates for electric service should have as simple a form as is consistent with a fair charge for the services rendered.

The customers of an electric plant can be considered under two classes: First, competitive customers; second, non-competitive customers. Competitive customers are those who are not dependent upon the electric plant for their supply of light or power, but may economically obtain their requirements from some other source. Their business should be sought at rates sufficiently high to yield the electric plant a profit on its additional costs to supply them, and sufficiently low to secure for the electric plant the maximum profit obtainable from this class of business. The only obligation of a public service corporation in establishing rates for this class of customers is that the charges shall be the same to all who require service in similar quantity and under similar conditions. This class includes power customers who can supply their requirements by steam or other power, and lighting customers large enough to make the installation of a private plant feasible. The business of such customers is exceedingly desirable if it can be obtained at a profit over the specific expenses incurred in supplying them, for the profit so obtained can be used to lessen the cost of service to the other class of customers. This has been the experience and practice throughout the industry.

The non-competitive customers consist of those customers who can obtain their supply of electricity by no other practical means than through the central station. The rates charged these customers should be such as to yield earnings which, when credited with the profit from competitive consumers, should be sufficient to pay operating expenses incurred in this class of service, taxes, depreciation and a reasonable return on the fair value of the property actually used for their convenience. On the other hand, the charge to each customer should not be more than the service required is reasonably worth to him.

What electric service for lighting is reasonably worth can be shown only by comparison with the cost of lighting (1) by other artificial means of illumination and a comparison of the relative advantages, and (2) by a comparison with the cost of electricity for the same purpose in other localities.

The cost of service in an electric plant differs from that of almost any other industry. Since the storage of electricity in large quantities is not commercially practicable, its product must be manufactured and delivered instantaneously upon demand. Thus a large portion of the cost of service consists of the "readiness to serve" cost which is fixed and is not a function of the quantity of electricity used. Hence, electric service cannot be sold with justice at a uniform flat price as is done in the water and gas industries. These fixed costs may be analyzed into two classes, one a demand cost, dependent on the greatest quantity required at any time from the plant, or the "maximum demand," so called. This cost includes such items as management expenses, insurance, legal expenses, etc. The other a consumer cost, dependent on the number of consumers, which includes such items as maintenance and operation of meters, of arc lamps, of pole lines, renewals of incandescent lamps, clerk hire, etc. In addition to the above the remaining expenses, which may be termed output expenses, are those proportional to the amount of electricity used, and consist of manufacturing expenses, such as coal, water, etc.

It is obviously desirable to have rates for electricity which shall apportion to each individual the cost of his service as closely as practicable. This has been attempted in many forms or rates with varying success. The most common forms in use are:

1. Block System, of which the following rate is an example, namely:

First 20 kw.hr. per month at	11c
Second 20 kw.-hr. per month at	10c
Third 20 kw.-hr. per month at	9c
All over 60 kw.-hr. per month at	8c

2. Wright System, where the charge for current decreases with the number of hours use of the demand or estimated demand, thus:

"13c per kw.-hr. for the first 30 hours use per month of the active connected load.

"9c per kw.-hr. for the next 60 hours use per month of the active connected load.

"5c per kw.-hr. for all additional current consumed."

This is the form of rate adopted by the Wisconsin Commission.

3. Hopkinson System, which consists of a fixed charge based on demand, or size of installation, in addition to a current charge, with quantity discounts increasing with the service charge to allow for decreased costs in supplying larger services.

4. Three Charge System, a further refinement of the above, dividing the fixed charge in two parts to cover (1) demand cost and (2) consumer cost, with a similar current charge to cover cost of manufacture or output cost.

The two latter rates are more scientific than the first two but have certain disadvantages in practical application. The method of determining the maximum demand is either by the use of maximum demand meters or by the assumption of an arbitrary percentage of the connected load for various classes of service. The former necessitates the expense of additional meters and in the end does not give the desired information as to the demand of the cus-

[1] Paper presented before N. W. Electric Light & Power Association, Portland, Sept. 11-13, 1912.

tomer at the time of the peak load on the station, which is the determining factor in the proper proportion of the demand costs. This method, therefore, fails in the very function for which it is designed, and does not result in as fair an assessment of these costs as can be obtained by a study of the requirements of various classes of service. Thus, by taking a feeder at the power station, which supplies only residential lighting, it is possible to ascertain the percentage of the load connected on this feeder to the demand on the feeder at the time of the peak load at the station. This percentage could then be applied to the connected load of each residential customer to obtain the basis of assessing the demand charges. This is the manner in which the "active" connected for various classes of service is determined for use in applying the rate adopted by the Wisconsin Commission. In order to use this system to obtain the fair apportionment of demand charges, it is necessary to keep an accurate record at all times of the individual customer's connected load. This is practically impossible because of the frequent changes made in the installations by the substitution of higher or lower candle power or wattage lamps. Furthermore, the demand system of charging, as assessed under the Wright, Hopkinson or Three Charge Systems, discourages the installation of lamps which might otherwise be installed for convenience, and which would have no effect on the peak load of the station, such as in closets, cellars, attics and for ornamental effects.

Residential customers in this community are sufficiently uniform in the size of their individual demands to be considered as a class. Thus, instead of attempting to assess upon each an arbitrary estimate of his individual demand cost, which is inevitably inaccurate, we believe that equal justice can be obtained by assessing each for the average of all. By taking the average residential demand on the power station at the time of its peak load, all of the advantages of the demand system of charge can be condensed in a rate on the Block System. We, therefore, contend that charges for residential lighting can be more adequately made under the Block System.

In the case of the commercial customers, however, the conditions of demand and hours of burning vary widely, from the office with a few lights and which closes at 5:00 o'clock, to the theatres with large connected loads, using current until 11:00 o'clock. The requirements of this class of customers are too varied to be covered by as simple a rate as that applicable to residences. It is necessary in assessing proper charges to the commercial customers to recognize the individual demands and hours of use. Let us assume, for the sake of argument, that the following rate is applied to this class of customers:

$0.0888 per kw.-hr., with minimum monthly guarantee of one-twelfth.......................................$33.50 per kw.-yr.
$0.0833 per kw.-hr., with minimum monthly guarantee of one-twelfth....................................... 40.20 per kw.-yr.
$0.0777 per kw.-hr., with minimum monthly guarantee of one-twelfth....................................... 47.00 per kw.-yr.
$0.0722 per kw.-hr., with minimum monthly guarantee of one-twelfth....................................... 53.70 per kw.-yr.
$0.0666 per kw.-hr., with minimum monthly guarantee of one-twelfth....................................... 60.20 per kw.-yr.
$0.0611 per kw.hr., with minimum monthly guarantee of one-twelfth....................................... 67.00 per kw.-yr.
$0.0555 per kw.-hr., with minimum monthly guarantee of one-twelfth....................................... 73.70 per kw.-yr.
$0.05 per kw.-hr., with minimum monthly guarantee of one-twelfth....................................... 80.50 per kw.-yr.
$0.0444 per kw.hr., with minimum monthly guarantee of one-twelfth....................................... 87.20 per kw.-yr.
$0.0388 per kw.-hr., with minimum monthly guarantee of one-twelfth....................................... 94.00 per kw.-yr.

This rate is of the type described under Wright System above, and differs from that adopted by the Wisconsin Commission only in wording and method of application. Thus, this rate in the form of expression used in the Wisconsin rates could be expressed as follows:

8c per kw.-hr. for the first 45 hours' use per month of the connected load.
5c per kw.-hr. for the next 45 hours' use per month of the connected load.
2½c per kw.-hr. for all additional current consumed.

The net cost per kilowatt hour for various hours' use per day under this commercial rate is plotted on the accompanying sheet. The points enclosed in circles show the costs under the above rate.

That the cost of service under the rates named above does not exceed what it is reasonably worth may be shown by a comparison with cost of other artificial illumination. The following tabulation of the comparative cost of light from various sources is taken from the Electrical World of April 20, 1911, and corrected for unit costs of the various sources, obtaining in this part of the country:

Comparative Costs of Light From Various Sources.

Source of Light.	Consumption for 100 Int. C.P. Hrs.	Candle Power Measured	Price of fuel or energy Cents	Cost of 100 C.P. Hrs., Cts.
Stearine Candle.....	2.25 lbs.	Horizontal	16 per lb.	36.0
Kerosene	.73 lbs.	Spherical	2.1 per lb.	1.53
Gas, Ordinary Burner.	67 cu.ft.	Spherical	135 per M.	9.05
Gas, Incandescent....	7.8 cu.ft.	Spherical	135 per M.	1.05
Gas, Inverted Incan..	6.4 cu.ft.	Spherical	135 per M.	.87
Elec. Carbon Filament	350 watts	Horizontal	9.9 per kw.-hr.	3.46
Nernst Lamp.......	165 watts	Horizontal	9.9 per kw.-hr.	1.63
Nernst Lamp.......	165 watts	Horizontal	7.5 per kw.-hr.	1.24
Tungsten Lamp	125 watts	Horizontal	9.9 per kw.-hr.	1.23
Tungsten Lamp	125 watts	Horizontal	5.5 per kw.-hr.	.69

You will note that electricity at the highest net rate costs 1.23c per 100 c.p. hour with tungsten lamp. The only artificial illuminant which shows a lower cost is the gas mantle. In comparing the cost of this type of lamp with the cost of lighting by electricity, it is necessary to consider the cost of the pilot flame, which burns constantly in gas lamps. The average residence uses light 850 hours per year. On the manufacturers' rating the inverted gas mantle lamps consume 3 1/3 cu. ft. per hour when in use, and the pilot ⅛ cu. ft. The consumption per year would then be

$$\begin{array}{rl} 850 \text{ hours at } 3.33 = & 2,833 \text{ cu. ft.} \\ 7,910 \text{ hours at } .125 = & 989 \text{ cu. ft.} \\ \hline & 3,822 \text{ cu. ft.} \end{array}$$

and the cost per year at a net price for gas of $1.35 would be, 3822 cu. ft. at $1.35 per M = $5.16. The average candle power of this lamp is 40.

A 48 candle power tungsten lamp consumes 60 watts per hour and the annual cost per year for the same number of hours burning at the maximum net rate would be

$$\frac{60 \times 850}{1000} = 5.1 \text{ kw.-hr. at } 9.9 = \$5.05$$

No comparison has been made of the relative cost of renewals of gas mantles and tungsten lamps. Both are fragile and their life consequently difficult to determine. If there is any advantage to the gas in this

respect, it is more than offset by the fact that we have considered every gas lamp used for the full 850 hours per year. Such would not be the case, for in certain locations the hours of actual burning would be less and the electric lamp correspondingly cheaper. Thus, the average number of hours' use of the total connected load in residences is approximately 190 hours per year. On this basis the cost for gas for a residence equipped with 20 inverted mantle lamps would be

$$\frac{20 \times 190 \times 3.33}{1000} \times 1.35 = \$17.10$$

$$\frac{20 \times 8570 \times .125}{1000} \times 1.35 = \underline{28.90}$$

$$\$46.00$$

The cost for electricity for a similar number of 60 watt Tungsten lamps would be

$$\frac{20 \times 190 \times 60}{1000} \times .99 = \$22.60$$

It is apparent that electricity at the rate of even 15c per kw.-hr. is the cheapest artificial illuminant available in this community. A discussion of the relative merits of the various sources of artificial light is therefore unnecessary.

The cost of electricity in other cities is shown in Table 1. A study of this table shows that the charges made by each of us are reasonable, when proper allowances are made for difference in size and conditions of supply.

It is therefore evident that the rates charged by the companies of this association are not in excess of what the service is reasonably worth. It now remains to determine whether the rates charged for different classes of service yield a reasonable return upon a fair valuation of the property employed. To determine this, it is necessary to make a detailed analysis of the earnings, expenses and fixed charges of the company under consideration. The expenses should first be divided into Output, Consumer and Demand Costs.

The Output Expenses should be divided between Lighting Service and Power Service in proportion to the kilowatt hours distributed for each, providing the company has separate feeders, for these classes of service. These expenses for the lighting service should be further subdivided into Residential, Commercial, Flat and Municipal. For this subdivision

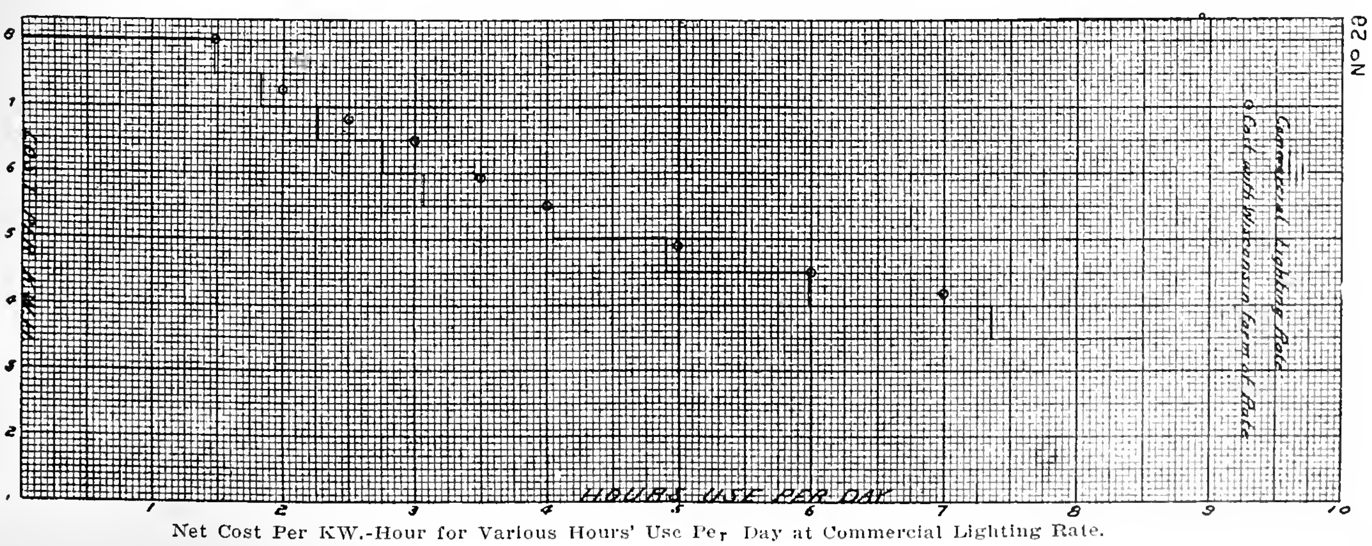
Maximum Net Rates and Yearly Guarantee Charged by Electric Companies in Northwest.

City.	Maximum. Net Rate.	Yearly Guarantee
Aberdeen, Wash.	9c	$12.00
Albany, Ore.	9.9c	......
Arlington, Wash.	15c	12.00
Anacortes, Wash.	13.5c	12.00
Bellingham, Wash.	10c	12.00
Chehalis, Wash.	11.4c	12.00
Clarkston, Wash., S. C. $1.50	9c	18.00
Colfax, Wash.	14c	15.00
The Dalles, Oregon	12c	12.00
Dayton, Wash.	12c	12.00
Eugene, Oregon	13.5c	12.00
Everett, Wash.	9.9c	12.00
Free Water, Oregon	12c	12.00
Granite Falls, Wash.	12.6c	12.00
Grandview, Wash.	13c	12.00
Granger, Wash.	13c	12.00
Goldendale, Wash.	13c	12.00
Glacier, Wash.	15c	12.00
Hood River, Oregon	12c	12.00
Kelso, Wash.	12c	12.00
Kennewick, Wash.	13c	12.00
Leavenworth, Wash.	13c	12.00
Mabton, Wash.	14.85c	9.00
Maple Falls, Wash.	15c	12.00
Medical Lake, Wash.	15c	12.00
Montesano, Wash.	11¼c	12.00
North Yakima, Wash.	12c	9.00
Odessa, Wash.	15c	12.00
Olympia, Wash.	18c	6.00
Pasco, Wash.	13c	12.00
Pendleton, Oregon	12c	12.00
Pomeroy, Wash.	13c	12.00
Port Townsend, Wash.	14.4c	12.00
Portland, Oregon	14¼c	12.00
Prosser, Wash.	13c	12.00
Richland, Wash.	13c	12.00
Rogue River, Wash.	10c	12.00
Sand Point, Idaho	13.5c	.....
Seattle, Wash.	7c	12.00
Sedro Woolley, Wash.	11c	12.00
Spokane, Wash.	10c	12.00
Stevens County (Colville)	12c	.....
Sunnyside, Wash.	13c	12.00
Tacoma, Wash.	6¼c	6.00
Toppenish, Wash.	11¼c	18.00
Walla Walla, Wash.	12c	12.00
Wallace, Idaho	16c	.....
Waitsburg, Wash.	12c	12.00
Wapato, Wash.	14.85c	9.00
Wenatchee, Wash.	13.5c	12.00
White Salmon, Wash.	12c	12.00
Wilbur, Wash.	20c	15.00

it will probably be necessary to use the kw.-hr. delivered to each class as the basis. This favors the residential, for it should stand a greater percentage of the transformer losses, but many of the lighting feeders supply several of these classes of service so that it is impossible to segregate the losses of distribution to each class.

The consumer expenses should be subdivided into these same classes on the basis of the number of consumers in each class of service, except such expenses as can be charged directly to its proper class. Thus, renewal of incandescent lamps is chargeable directly to lighting, and operation and maintenance of arc lamps are chargeable directly to commercial lighting and municipal lighting.

The demand expenses should be apportioned in



Net Cost Per KW.-Hour for Various Hours' Use Per Day at Commercial Lighting Rate.

accordance with the demands of the respective classes of service on the power station at the time of its peak load.

As shown at the beginning of this paper, competitive customers should be supplied at rates sufficient to obtain a profit on the additional costs of supplying them. This class of service should be charged only with the additional operating expenses incurred in their service. Our taxes, depreciation and fair return would be the same if we did not have their business, which is in the nature of a by-product, and it would be impossible to obtain their business if they were obliged to pay such charges.

The above described analysis should be tabulated under each of the subdivisions and the total of output consumer, demand expenses, taxes, depreciation, and interest and profit, subtracted from the net revenue in each class of service. The balance will show the justice of the rates charged for each class. An analysis of this character wes made for one of the member companies, which showed that in every case the non-competitive consumers were served at a loss and the competitive consumers at a profit. The total loss in non-competitive service, which amounted to $20,000.00, was largely offset by the profit from competitive service, which amounted to $14,500.00.

This analysis should be carried further to determine the justice of rates with respect to the individual in each class. Thus, in investigation above referred to the average connected load of all residential consumers was determined, and the ratio of this connected load to the residential lighting demand on the power station at the time of its peak load, in short, the diversity factor. The total connected load in residential lighting service was found to be 2870 kw. with 2653 customers, an average of 1.08 kw. for each residence. The maximum residential lighting demand at the time of peak load was 445 kw. or an average of 0.168 kw. for each residence. This gave a diversity factor of 6.4, which compares favorably with tests made by the Commonwealth Edison Company, which showed 6.2 per cent. With this information, it is possible to obtain from the analysis of residential lighting costs, unit costs of demand, consumer and current for the average residence, which can be plotted beside the rate charged.

Similar comparisons should be made for other classes of competitive service. When these comparisons have been completed, your rates will be justifiable,

1st. If your charges are not more than the service is reasonably worth to the consumer.

2d. If you are not, in the aggregate, earning more than a fair return upon the value of your property.

3d. If your competitive customers are being served at a profit.

4th. If your non-competitive customers are not served at a profit in excess of that to which you are entitled on your plant as a whole, minus that which is obtained from your competitive customers.

5th. If no one class of non-competitive service is yielding an undue profit.

6th. If your rates assess the individuals in each class of service fairly.

ARNOLD'S NINTH PRELIMINARY REPORT.

Present Transportation Conditions, San Francisco and Vicinity.

Bion J. Arnold's preliminary report No. 9 on present transportation conditions in San Francisco and vicinity was submitted to the Board of Supervisors on September 19, 1912. The report begins with a detailed analysis of the elements of the problem, continues with a discussion of local conditions and concludes with a development program for the city and corporation.

In the course of the discussion it is shown that transportation facilities have not kept pace with the rapid growth of the city commercially and in population. The city is not in a position to acquire the existing railway system, franchise conditions are such that private capital cannot be expected to make needed extensions and therefore their mutual effort is necessary to bring about needed improvements.

A time zone map, which accompanies the report, shows that although the greater part of the city's area could be reached in 30 minutes by improved methods of transportation, yet at present only about half its area has been developed. From the rate zone map it is seen that a five per cent commutation rate has diverted traffic to the east side of San Francisco Bay "by a system of electrification which finds no parallel in this country."

"The riding habit, as expressed in earnings per capita from transportation, is here the highest of any city in the country, and almost twice as high as the average city." "The earning capacity is available. It only remains to develop a transit policy commensurate to the opportunity and to execute the policy with courage and dispatch."

The topography and city plan tend to cause sectional isolation and congestion. The climate gives "ideal working conditions" throughout the city. Yet a traffic count indicates "a wide variation in the general character of service on the individual routes, * * * all of which can be remedied by additional equipment and re-routing of cars."

"The Charter provisions and the underlying theory with respect to private capital will have to be modified, or else it is incumbent upon the city to buy its utilities at once at a considerable premium. It cannot force private capital to invest under conditions considered unprofitable. At the same time, there are extensions which cannot be made by the city, but ought to be made by the corporation, and vice versa. And it is believed that the corporation would then cheerfully extend into non-competitive territory, even in the face of the city's avowed intention of forcing out private capital. In my judgment, therefore, certain steps could well be taken at the present time to remedy these conditions:

"First—The Charter may be amended so as to make private investment possible.

"Second—Present corporate franchises may be merged on some equitable basis of equalization with extension franchises desired.

"Third—Duplication of investment may be avoided by non-competitive extensions, with the object of ultimate unification of the entire property at the lowest possible investment cost.

"Without a real solution of this major problem, all of the minor activities proposed in this report and by other organized bodies having the interests of the city at heart will be entirely frustrated. The question of a sane, reasonable, and workable franchise agreement between the city and the United Railroads is the first great matter to be settled, to which all others are subordinate, and no time should be lost in formulating a plan for submission to the voters in November.

"It is necessary for me to say here that the evolution of this much-desired plan will not be furthered by the use of old arguments and the useless discussion of former abuses and unfortunate occurrences in the history of civic and traction development, by both sides of the controversy, to force concessions. Progress is not retroactive. Conditions exist as they are, without reference to the past, and a solution must be found for today and tomorrow rather than yesterday. Consequently, the application of radical restraints to the present situation will utterly defeat the purpose of the sober and determined citizens of this city to record a fresh page in the history of their civic development.

"The most hopeful fact in relation to this proposed agreement is that the California municipalities have unquestioned jurisdiction over their public utilities in a regulative or supervisory capacity—that is, over rates, service and equipment, and to some degree over extensions. When it is considered that some of the older Eastern cities have virtually lost control of their streets and through gross misjudgment have awarded franchises running as high as 999 years without compensation, with standards of service on the lowest plane, with the corporations on the verge of bankruptcy by reason of the excessive burdens of securities issued upon these perpetual franchises, with the riding habit curtailed by this poor habilitation and extensions under the prevailing finanservice, and with little hope of new capital for recial plan, the position of San Francisco is enviable, indeed. The power lies within its hands to evolve a magnificent transportation system under the impetus of high earning capacity. With sane regulation and the recognition of the rights of private capital, it will be possible for the city to develop along logical lines, both its municipal and its private systems with a certainty of ultimate unification. It goes without saying that such regulation must be practical and not punitive, and one of the first requisites is for the municipal legislative body to create and maintain a commission of technically trained men to carry out this highly technical business and relieve the legislative body from the consideration of the innumerable details of such a business. The time and training of a legislator does not permit him to engage in the operation of a public utility.

"Such a commission must have complete and unquestioned authority over all operating, construction and financial matters, except the purely legislative function of granting franchises. There is no middle ground of divided responsibility. And if conditions with regard to term of office, compensation and technical training cannot be made so as to create a commission of adequate ability and of absolutely independent political connection, then a simple bureau or branch of the city government would be preferable, having advisory and investigative powers only. But the former would be more desirable, and is directly in line with the establishment of the first and second district commissions of New York, having respective jurisdictions over the city and state of New York.

"Summarizing, the foregoing may best be epitomized in the form of a development program to be followed out by both city and company in effecting a solution of the present difficulties. The city has unquestionably been greatly handicapped in its development by the failure of the transit companies to keep pace with its rapid rise in civic standards, as well as in magnitude. But the problems of the future have not been fully appreciated in the past, and as a result of lax municipal control, abuses have crept in, which should now be remedied.

"It must be apparent that until the city is able to purchase its utilities at a fair price, it must depend upon them for service. Consequently the interests of city and corporation are most intimately identified in the matter of transportation, and it is upon this premise that the following program is suggested. Urgent action upon the major problem is most necessary."

Development Program for City and Corporation.

Immediate.

I. City to amend Charter and ordinances to invite and secure private capital in traction enterprises until city is ready to acquire its utilities.

II. Enter into conference with regard to extensions, equalization of franchise life, terms imposed, co-operative settlement plan, etc.:
 (a) Future extension projects;
 (b) Status of present franchises.

III. Determine and provide for transportation facilities to Panama-Pacific Exposition grounds.

IV. Company to acquire additional equipment as rapidly as possible, until proper standard of service is reached.

V. Company to press rehabilitation of all parts of operating system until fully standardized.

Thereafter.

VI. Progressive evolution of city plan for facilitating more rapid car operation by tunnels and other means.

VII. Continuous program of extensions, preferably non-competitive.

VIII. Rerouting and redistribution of service, proportionate to actual traffic requirements.

IX. Progressive retirement of obsolete equipment, and uniform increase in new equipment proportionate to growth in population.

X. Reorganization of financial system, to support adequate depreciation and renewal fund out of earnings.

XI. Progressive system of renewals, to provide for inadequate and obsolete property.

XII. Establishment of impartial regulation and supervision of municipal utilities.

XIII. Development of bay cities under Metropolitan-District Control.

XIV. Progressive unification of operating utilities, and development of financial plan for ultimate acquisition by city.

XV. Development of transit facilities, with eventual rapid transit subway and surface lines in view.

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POWER AND GAS

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895
Entry changed to "The Journal of Electricity," September, 1895.
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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Technical Writing

The teaching of journalism in American universities is becoming recognized more and more as of deep importance. Indeed no field of activity in these modern times offers broader opportunities for useful and helpful service than does the field of journalism. The University of Washington some time since has established a school of journalism and at this writing Eric W. Allen of the Seattle Post-Intelligencer is leaving for Eugene, Oregon, to undertake a similar work at the University of Oregon.

It is to be hoped that technical writing will receive its due emphasis at these universities. The West is today producing world-beating engineering accomplishments, not alone in construction but in design and technical theory. To properly set forth such work, requires the master pen of the technical writer. Many of our social and economic problems are so finely interwoven with technical terms that our rate-making bodies must look to some one who can forcefully and clearly set them forth in non-technical language. But even if the student did not actually pursue a career after graduation as a technical writer, the power of the pen in mastering a clever, forceful, elegant style will serve him on many an occasion in the after years of busy struggle with engineering reports and specifications.

A Life of Service

Many are born to live but few to lead. In the passing of Jas. H. Wise, assistant general manager of the Pacific Gas & Electric Company, the West has lost a born leader. Yet, it is not for leadership alone that his loss is so keenly felt. It has been truly said that "all the world loves a lover." The enthusiasm and love shown for his work was reflected in the lives of all who knew him.

Here was a young man scarcely in his thirties, yet unquestionably soon to be recognized of national, if not international standing as an engineer. As a citizen he was of the highest order, and as an engineer he possessed all those traits which point out the highest attainments—ability, painstaking accuracy, integrity, a mastery over the minutest details and an enthusiastic love for his work which swept everything before it. When in the maddened struggle of life a character is encountered, such as Mr. Wise possessed, so sweet, so kindly, and yet withal so full of the juice of life, some are wont to question the deep purpose of the Almighty in snatching from us—unwarned—such chosen vessels of engineering talent and inspiration.

We pause to answer its profound significance. Philosophers down through the ages have speculated over this subject. Yet of this we are convinced, that the world is better, is brighter, and life's struggle more hopeful, from having had them with us, though their stay be brief. Let us, then, put aside idle speculation and endeavor in our own lives to absorb those beautiful and wholesome ideals they possessed. Let us remember, though the column of Jas. H. Wise is now broken and, though in a worldly sense his work is unfinished, yet his young love and enthusiasm may

ever be with us. Indeed so wholesome was his life only in biblical words of the taking of Enock may his passing be written, and Jas. H. Wise "was not for God took him."

Municipal District Control

Certain points touched upon by Mr. Arnold, discussing elsewhere in this issue the present transportation conditions in San Francisco and vicinity, are of interest to engineers and the public generally throughout the coast cities. The question of municipal control as opposed to state-wide regulation is now a heated topic of discussion in Oregon awaiting the final voice of the people in the November ballots. In California, too, since the recent public utilities act leaves it optional with the municipalities as to their coming under state-wide control, the issue is strongly agitated at the present time.

Many things are daily transpiring which strongly indicate that the wiser procedure would be for the municipalities to take advantage of the opportunities offered under regulation by the Railroad Commission. Not long since a discussion of rates for Oakland, Berkeley and Alameda brought out the inconsistencies there in vogue. Though by their very interlinking proximity these municipalities are one and the same community, wide variance was shown in rate fixing and service, and yet under separate jurisdiction no remedy is evident.

In his report Mr. Arnold forcefully points out the needs of a technical commission, composed of high class experts. Yet in face of his statement that San Francisco must conserve her financial resources, he advises the appointment of a municipal commission. In addition to this need of a board of expensive experts, Mr. Arnold forcefully points out the future growth of the cities about the bay region and the necessity for unified action. In 1925, it is conservatively estimated that this community will have a total population of 1,400,000 people, 600,000 of whom, he estimates, will live within the confines of San Francisco. To bring about unified development, the needs and interlinking necessities of these neighboring municipalities must be taken into consideration not alone by a board looking to the selfish interests of San Francisco, but the entire district as a unit.

In the closing article of the recently enacted public utilities act of California it is distinctly set forth that municipalities may retain control of public utilities within their confines, or may by proper procedure surrender such control to the Railroad Commission, reserving unto themselves the privilege of withdrawing again at a subsequent date if so desired.

Here now is a city in which not alone the bay region is interested but indeed the nation. If ever an opportunity presented itself for fair and unhampered trial, this is the occasion. It is up to San Francisco and the region surrounding the bay to rise to the emergency. Let them surrender to the state commission the rights of regulating rates and service for a reasonable trial. This is the only immediate remedy and the good of the great exposition of 1915 with the resultant healthful growth to these communities demands prompt action.

Western Enthusiasm

Fully apace with Western hydroelectric development is that of every other feature which goes toward substantial growth in this enterprising and promising section of our country. As a rule it takes an agitation of many months to bring about actual construction. At the present time many great projects are in various stages of completion. The Los Angeles Aqueduct, the Big Creek project of the Pacific Light & Power Company, the Big Meadows dam of the Great Western Power Company, and the development of an additional 100,000 horsepower at Lake Spalding by the Pacific Gas & Electric Company make all observers stand with bared head in awe and admiration of Western accomplishment and confidence for the future.

Every district of the West is indeed alive with plans and projects, each one being of a more comprehensive and daring nature than ever before attempted —such continued enlarged effort is indeed characteristic of a community fully alert to its latent possibilities. At Seattle an agitation is under way which proposes the erecting of a mammoth steel and concrete bridge spanning Lake Washington from the end of Bailey peninsula to Mercer island. This project, wherein a single span will measure 3400 ft., is estimated to cost some eight million dollars. A wide and beautiful area will thus be brought within easy access to the city.

Enthusiasm still runs high in good-road building agitation. A scenic highway over the Cascades near Wenatchee, Wash., is now being discussed. Then, too, the building of a mammoth bridge over the Columbia River near Vancouver, Wash., as an important feature of the Pacific Highway is receiving strong support in both the interested states, Oregon and Washington.

The development of a domestic supply of water for San Francisco and neighboring cities still holds the attention of all interested. The Hetch Hetchy scheme proposed by the noted consulting expert, John R. Freeman, is more daring and on a more gigantic scale than any similar project hitherto undertaken.

The enthusiasm of the West begot in the exciting days of forty-nine has evolutionized from that of eager gold hunting for treasure awaiting but the asking to that of creative wealth. This modern enthusiasm is building productive empires by means of sheer audacity—and yet an audacity that makes good its boast..

The men of the West who have accomplished and who are accomplishing these great triumphs are not themselves men of wealth. The ultimate analysis shows that, after all, Western enthusiasm is the sole sponsor. Enthusiasm is indeed as Henry Chester has recently said, the greatest asset in the world. To it money power and influence must bow the head. Single handed the enthusiast convinces and dominates where wealth accumulated by a small army of workers would scarcely raise a tremor of interest. Enthusiasm tramples over prejudice and opposition, spurns inaction, storms the citadel of its object, and, like the rushing torrents of the high Sierras overwhelms and engulfs all obstacles.

PERSONALS.

R. D. Holabird, president of the Holabird-Reynolds Company, is spending a couple of weeks at his northwestern house at Seattle.

Thomas A. Cashin, superintendent of the Fresno Traction Company, has been selected for superintendent of the Geary Street Municipal Railway at San Francisco.

I. F. Watkins, editor of the London Statist, is visiting the Pacific Coast to secure data for a series of articles on the electric power development possibilities of the State of California.

Geo. C. Holberton, San Francisco district manager for the Pacific Gas and Electric Company, and **H. C. Vensano,** civil engineer for the company, have returned to San Francisco from the East.

F. B. Lewis, formerly engineer of light and power in the department of distribution of the Southern California Edison Company, has been promoted to the position of superintendent of the Los Angeles district.

Herbert Fleishhacker is at Portland, Ore., on business connected with the Northwestern Electric Company, which is preparing to transmit power to that city from a new hydroelectric plant at White Salmon.

C. E. Bailey, manager of the reporting division of the engineering department of J. G. White & Co. of New York, recently arrived from the East and has been inspecting some of the interurban electric railway work that is being done by his firm.

K. G. Dunn, electrical engineeer with Hunt, Mirk & Co. is visiting San Diego in connection with the system's underground steam mains which are being installed under his firm's supervision for the San Diego Electric Railway interests.

R. S. Buck of Sanderson & Porter's Pacific Coast department, recently returned to San Francisco, after visiting Vancouver and Victoria, B. C., and inspecting an important water works project which is being carried out under the supervision of his firm.

H. V. Carter, president of the Pacific States Electric Company, has returned to San Francisco from an extensive trip throughout the Northwest, during the course of which he attended the convention of the Northwest Electric Light and Power Association at Portland.

T. M. Hurlburt, engineer for the city of Portland, will read a paper before the Oregon Society of Engineers October 10, at their quarterly dinner on the "Treatment of Portland's Sewage Drainage System, Present and Future; also Suggested Improvement of Columbia Slough as a Roadstead."

John T. Huntington has been appointed manager of the Santa Barbara Gas & Electric Company, at Santa Barbara, Cal. **S. C. Haver, Jr.,** who has been acting manager in Santa Barbara, has returned to his regular position as assistant district agent of the Southern California Edison Company, in Los Angeles.

S. O. Jayne, government irrigation expert, has been detailed by Dr. Fortier, in charge of irrigation and reclamation work for the government, to investigate the use and merits of wood pipe for distribution of water, with particular stress on its use in irrigation pipe lines, etc. Mr. Jayne is now in eastern Washington.

J. R. Bibbins, resident engineer for Bion J. Arnold, the traction expert employed by the City of San Francisco in connection with its street railway problems, delivered an address at the Commonwealth Club's last weekly luncheon, on the subject "The Development and Expansion of San Francisco Through the Medium of the Market-Street Extension Tunnel Under Twin Peaks."

PACIFIC COAST GAS ASSOCIATION CONVENTION.

The twentieth annual convention of the Pacific Coast Gas Association at San Diego, September 17, 18, and 19, proved a most successful gathering.

The papers presented, a detailed list of which was previously published in those columns, proved of much help to the member companies. President Wm. Baurhyte opened the sessions of the convention with a masterly discussion of the pertinent problems now before the member companies of the association. In particular corporation control by the regulating commissions and the raising of funds for the proposed courses in gas engineering at the University of California were ably discussed.

The paper entitled "Should Gas Companies Engage in the Sale of Appliances" by Messrs. L. H. Newbert and H. P. Pitts brought out a most intense discussion. The conclusions emphasized by L. P. Howe perhaps set forth the conclusions deduced from the discussion; namely, a gas company should endeavor to get business by any honorable means possible, even though this necessitated the giving away of gas appliances at times.

Leon B. Jones presented a technical paper of high order on "Welding of High Pressure Pipe Lines." This paper appeared in full in our last issue. The welding of pipe was actually illustrated in the convention hall, which proved of lively interest to all.

C. L. Cory, professor of electrical enineering at the University of California, was awarded the gold medal for his paper on "Reasonable Gas Rates and Their Determination." The paper is to be printed and distributed among the member companies as setting forth a method of determination just to public and corporation alike.

Robert Sibley, editor of this journal, presented a paper on "Gas Engineering in American Universities." The paper set forth in detail a proposed course to be instituted at the University of California. The paper was interestingly discussed and met with the hearty approval and approbation of the delegates. This paper appeared in full in the last issue of this journal.

At the conclusion of the sessions, the convention decided to meet at San Jose next year. The following officers were then elected for the ensuing year: President, Henry E. Adams of Stockton, Cal.; vice-president, C. S. Vance of Los Angeles; secretary, Henry Bostwick of San Francisco.

San Diegans certainly proved themselves ideal hosts. H. H. Jones of the San Diego Consolidated Gas & Electric Company, is to be congratulated upon the pleasure and profit enjoyed by all attending this convention.

The outings so thoroughly enjoyed by the guests were as follows: On Tuesday, September 17th and Wednesday, September 18th, the ladies of the party were entertained by automobile sight-seeing trips in and around San Diego. The banquet was held in the Grant Hotel on Wednesday evening, September the 18th, at seven o'clock. On this occasion the ladies of the party were the guests of the San Diego Consolidated Gas & Electric Company at a theatre party. On Thursday, September 19th, the members of the association and ladies accompanying them were taken in automobiles to all points of interest in and around San Diego as guests of the San Diego Consolidated Gas & Electric Company, returning to the Grant Hotel at noon, where luncheon was served. After luncheon, the party as guests of the United Light, Fuel & Power Company, were taken for a trip around San Diego Bay, returning to San Diego at 5 o'clock p. m. On Thursday evening, September 19th, a ball was given at the Grant Hotel by the San Diego Consolidated Gas & Electric Company for the members of the association, ladies of the party and invited guests.

REMOVAL NOTICES.

H. N. Lauritizen, Pacific Coast sales manager for the Holophane System of Illumination on the Ivelite Works of the General Electric Company, announces that the San Francisco sales rooms will be moved from 151 New Montgomery street to the Aronson Building, 86 Third street, on October 1st.

F. H. Poss, branch manager for the Benjamin Electric Company, on September 1st moved the San Francisco offices to the Rialto Building, where commodious quarters have been established at rooms 338, 340 and 342. A large stock of Benjamin specialties is carried at the new warehouse at 590 Howard street.

The Pacific States Electric Company plan to occupy the new six-story building now being constructed on Mission street, near Second, San Francisco, about December 15th. This is to be the general and distributing headquarters of the company and will be equipped with the most up-to-date features for the expeditious transaction of business. The ground and lower floors will be occupied by the sales and store rooms, while the general and executive offices will be located on the upper stories. The building is designed by Mr. Leo J. Devlin, architect.

CONVENTION ASSOCIATION RAILWAY ELECTRICAL ENGINEERS.

The fifth annual convention of the Association of Railway Electrical Engineers will be held in the Auditorium Hotel, Chicago, October 21-25. The electrical men of all the big railroads of the United States and Canada will here be gathered together for a conference on standardization of electrical practice on steam railroads, and many valuable papers and committee reports are planned.

SPOKANE JOVIANS.

Mr. V. G. Shinkle, Jovian Statesman for Washington, advises that there are about 60 members of the Rejuvenated Sons of Jove at Spokane, and they have a successful luncheon club which meets in the east room of Davenport's restaurant the second and fourth Tuesdays of each month. On Tuesday evening, September 24th, the chairman was C. R. Beau, the local representative of John A. Roebling's Sons Company. The principal address was given by Dan R. Brown on the Manufacture of Cement. Mr. Brown is assistant treasurer and manager of the Inland Portland Cement Company, Metaline Falls, Washington. At the Rejuvenation of Jovian Day, September 10th, twelve candidates were initiated. The initiation was in the Stone Room of the Spokane Hotel from 7 to 8:30 o'clock, after which they all went to the Orpheum Theatre where a section of seats was reserved. After the performance they returned to the Stone Room where a Dutch lunch was served. R. C. Kemp, Statesman for Montana, was toastmaster.

STEEL OR IRON CABINETS IN OREGON.

After November 15, 1912, the Underwriters' Equitable Rating Bureau of Portland will not sanction the installation of any steel or iron cabinets except those bearing the Underwriters' Label or those approved by them. (See April, 1912, List of Approved Electrical Fittings). This list is revised every six months, consequently it may not be complete; therefore it will be necessary to take up specific instance with the Bureau direct.

"Steel or Iron Cabinets" are required by the National Electric Code in mixed "knob and tube" and "conduit" installations; also that "Steel or Iron Cabinets" may be used with "knob and tube" work. Note that this does not apply to wooden cabinets.

ENGINEERS' LUNCHEON AT PORTLAND.

In accordance with the decision of the Joint Committee of the Oregon Society of Engineers, American Institute of Architects, American Society Civil Engineers, American Institute Electrical Engineers and National Electric Light Association, there was held a luncheon at the Imperial Hotel at 12:15 p. m. Tuesday, the 17th inst., which was a very gratifying success. This luncheon is intended to provide an informal meeting place for engineers and architects of all organizations.

The luncheon was entirely informal, with D. C. Henry, C. E., acting as the toastmaster. No formal speeches were made, but each guest was requested to talk long enough to tell those present who he was and in what character of business engaged.

Mr. Frank Logan of the Portland Chapter of the American Institute of Architects, invited all the engineering organizations to join the Portland Chapter of architects in maintaining permanent headquarters for engineers at their present club rooms at Third and Stark streets.

The joint committee, which had arranged for this luncheon, was retained by acclamation, with instructions to prepare for another at the same place on next Tuesday and have a place outlined for a permanent organization, with an object in view of securing and maintaining permanent clubrooms.

The following are the names of those attending:

Names of Engineers and Architects at Lunch.

M. Moran	J. F. Hoss	Walter H. Graves
J. D. Asher	O. La Fever	R. F. Monges
J. Peterson	J. J. Burling	G. A. Kumber
Frank Logan	F. S. Allgn	F. D. Weber
J. C. Strong	M. E. Reed	A. S. Moody
O. H. Wright	B. Anderson	G. H. Sherwood
E. F. Cautine	D. D. Clarke	G. M. Barthold
Henry M. Morse	J. H. Cunningham	Edward A. West
H. W. Harps	C. W. Raynor	D. F. McLee
T. C. Green	J. A. Currey	C. P. Osborne
H. A. Sumner	Douglas W. Taylor	O. E. Stanley
Edwin A. Taylor	Arthur D. Leach	H. E. Abry
H. R. Wakeman	Oscar Beck	W. G. Holford
L. B. Cramer	Henry Blood	W. I. Kalter
W. K. Kretsinger	S. B. Clark	John D. Ripley
G. P. Nock	R. S. Canoll	E. A. Middlebrooks
I. Dent	John Hatton	T. M. Hurlburt
B. W. Campbell	E. S. Whetney	L. H. Dittrich
R. Z. Myers	E. Tearing	C. C. Robbins
D. H. Lane	A. A. Poppleton	H. E. Plummer
F. Johnson	W. H. Evans	John P. Larknes
G. N. Barner	J. R. Hart	C. A. Merriam
William Neilson	C. A. Whipple	E. W Lazell
W. E. Hening	Paul Lebenbaum	H. L. Vorse
O. B. Helt	Felix A. Burton	Wm. S. Turner
W. L. Cook	Thomas Hawkes	D. S. Henny
V. A. Dorsveski	Robert Edwards	G. Hegardt
J. C. Martin		

SANDERSON & PORTER HANDLE ARIZONA RATE CASE.

Sanderson & Porter of New York and San Francisco have been handling for the Tucson Gas, Electric Light & Power Company of Tucson, Arizona and its owners the Federal Light & Traction Company of New York, the rate case arising under the new Arizona Corporation Commission law, (Senate bill 132), which involved an inventory and appraisal of the physical property and a valuation of the over head and intangible items, including the property and business of the company. Hearings before the commission extended over some nine days and the case has been recently adjourned for the preparation and filing of briefs and for arguments thereon, time for which has been set for January, 1913.

Mr. Francis Blossom, a member of the firm of Sanderson & Porter has generally directed the handling of the case, the legal features and argument having been made by Mr. John M. Olin of Madison, Wisconsin. A number of members of the staff of Sanderson & Porter, including Mr. H. W. Crozier of their San Francisco office, were engaged in preparation and presentation of this case.

The decision of the Arizona Corporation Commission is expected to indicate its attitude toward values and the rate of return which it considers reasonable and proper on gas and electric utilities in Arizona.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

IS THE ELECTRICAL HAZARD A CLASSIC MYTH?[1]

BY F. D. WEBER,

Electrical Inspector Underwriters' Equitable Rating Bureau.

"The fire losses in the United States in 1910 would pay the total interest bearing debt of the country in four years. They would build the Panama Canal in less than two years. If all the buildings burned last year in the United States were placed close together on both sides of the street, they would make an avenue of desolation reaching from Chicago to New York. At each thousand feet would be a building from which a severely injured person had been rescued and every three-fourths of a mile there would be the blackened ruins of a house in which some one had been burned to death."

Just pause for a minute and think of these statistics. In this age of conservation many of our citizens never even give this terrific waste a thought. They say let the insurance companies pay. The insurance companies do not pay these losses. The people pay and the insurance companies are only the tax collectors. Insurance rates must be made adequate to meet this loss or the companies cannot meet their obligations.

Insurance Commissioner Hotchkiss of New York says: "The need for more good reliable fire insurance by the people of New York City is more serious than the need for bread."

I have brought with me special copies of the paper on the fire waste by the Honorable Walter L. Fisher, Secretary of the Interior of the United States, which I desire you to read over carefully. It points out the fact that the fire waste is a national problem of vast magnitude.

With this appalling record what would the record have been if a movement had not been started to prevent this terrific waste. The world's great system of credit is based upon created wealth. When this created wealth is burned it never can be recreated and can only be replaced, so long as the country has in reserve the necessary resorces to replace same.

The part of the fire waste, we as Underwriters and also your organization "The Sons of Jove," are directly interested in, is the fire waste caused by defective electric wiring and the installation of the defective materials and apparatus. It has been estimated by a great many authorities that from 5 to 10 per cent of this fire waste is due to defective electric conditions.

Very early in the history of the electrical science the Underwriters' Inspectors were most forcibly brought face to face with this condition in the New England states. In 1881 there were 65 installations of electric lighting in the textile mills and all were insured in the Manufactures' Mutual Insurance Company, of New England, as those mills were visited in the brief period of six months, in 1881, by 26 fires all from electrical causes.

Now it has been, and is today, the policy of the Fire Underwriters not to condemn a new system, device or plan, until they have conducted a series of careful tests in order to discover whether it may not safely be used.

Dr. C. J. H Woodburn who, in 1881, was in the employ of the Manufactures' Mutual Insurance Company, as their engineer, conducted a series of experiments in the city of Cleveland. These experiments were along conditions similar to those that had caused the fires in the textile mills of New England. In these experiments he had the valuable assistance of Dr. Chas. F. Brush, Prof. Thompson, Mr. Weston and Mr. Edison and others and as a partial result of the experiments Dr. Woodbury formulated what was undoubtedly the first set of rules for such installations. The rules were dated October 28, 1881, and were preceded by, one day, by the rules issued by the New York Board of Fire Underwriters.

Until 1890 the various boards and bureaus formulated rules of their own without regard to uniformity. In 1891 the N. E. L. A. printed the rules they had formulated, adding more confusion. Mr. C. M. Goddard, the secretary of the New England exchange in 1892, corresponded with the electrical inspectors of the various underwriters' organizations and suggested a general meeting to be held in New York City in August. The rules of the National Electric Light Association which in 1894, formerly adopted the first electric code. In 1906 every one engaged in the electric business was invited to a joint conference on the rules. The outgrowth of these meetings was the formation of the "National Conference" on the standard electric rules. This committee recodified and amended the rules and presented them late in 1896, with the following note: "The National Electric Code as it is here presented, is the result of the united efforts of the various electric, insurance, architectural and allied interest which have through the national conference on standard electric rules, composed of delegates from the various national associations, unanimously voted to recommend them to their respective associaton for approval and adoption."

Now, gentlemen, I have traced the history of the national electric code from the first crude outline for textile mills to the time when it was adopted by the national conference. In general form the rules are the same today as they were originally, changes being made only to keep abreast of the times.

The national conference has disbanded and the work of the Underwriters' National Electric Association and the National Conference having been taken over by the National Fire Protection Association. The associations formerly members of the National Conference are represented on the Electric Committee of the National Fire Protection Association.

In 1893 a bureau for the testing of devices and materials and for dissemination of information was established in Chicago, in charge of a member of the electrical committee. This institution has made over 5000 reports on various subjects and appliances and last year issued over 20,000,000 stamps to be placed on approved apparatus and materials.

The laboratories labeling system is ideal in that the people who do the certifying have a financial interest, presumably equivalent to that of the purchaser, in the ability of the labeled article to properly perform its designed functions.

I will cite a few instances where a system of this kind would prove serviceable:

"Seven years ago a man put ten cents worth of baking soda in a five-cent tin tube. He sold it for three dollars as a fire extinguisher to use in the stage chamber of the Iroquois Theatre in Chicago. At a Christmas pantomine this great chamber was hung with flimsy draperies representing fairyland. One of these draperies was ignited by a spark from an electric lamp representing a moon. The operator testified that the fire in its incipiency could have easily been extinguished by a small stream of water, but the unreal extinguisher being at hand, he used it as directed, expecting the magic wand to be effective in such surroundings. Unfortunately, there was nothing "make-believe" about the fire, and the result was and always will be very real to the families and the friends of over six hundred women and children. whose lives were sacrificed that a man might make a profit of two dollars. I have not heard that the faker was punished. One of his confreres offering the same line of goods recently received the endorsement of a leading official of a great state, who, in lessons he had prepared for the instruction of school

[1]Talk before "Sons of Jove" lunch at Portland, Ore, September 19, 1912.

children and until their limitations were called to his attention, recommended these appliances as suitable for general use.

"Of course, there must be some talking point and an item of reality in connection with all such appliances. The so-called dry powder fire extinguisher will quickly and dramatically subdue a small quantity of gasolene burning in a cuspidor, and it will act similarly with certain other small fires in confined spaces. The point is, we do not have many gasoline fires in cuspidors; we cannot educate our fires to meet the limitations of the specialty extinguisher.

"Certain brands of so-called rubber-covered wire, conducting that subtle form of energy, electricity, through the concealed spaces of our houses, are sold for about the price of the copper they contain. If any real rubber is used in their coverings the fact has escaped the observation of a number of enlightened investigators"

Now, what can "The Sons of Jove" do in the state of Oregon to instill into the general public the feeling that the great fire waste is a burden they all bear? A great many of your members meet a great number of people connected directly or indirectly with the electric trade. These people are scattered all over the state of Oregon and take the "tip" about materials, apparatus, etc., from you. You continually have the question put to you: "Will the Underwriters pass this or that fitting or piece of apparatus." Now if it is on the "ragged edge" make a stand for conservation and tell the prospective customers the facts and always make an effort to persuade him to buy a superior product if possible, also take a few minutes to explain to him why the Underwriters do not approve all apparatus which seems to be a properly designed piece of apparatus from the purchaser's standpoint and on which the price is very inviting. Also it might be well to call to his attention that some of the best authorities in this country have devoted a great deal of time and money in trying to lessen the fire hazard and that the "old time" prejudice that the Underwriters own stock in all these concerns that manufacture electric apparatus and appliances was the only "classic myth" connected with the business.

The Underwriters in the state of Oregon endeavor to inspect all business property and special hazard in all the large towns in the state of Oregon, but they cannot watch but a small percentage of all the work installed, therefore, we desire to enlist all the aid possible in this campaign against the "fire hazard" and we know of no one better adapted to take up this "missionary work" with us than "The Sons of Jove."

TRADE NOTES.

The Redwood Manufacturers' Company, with plant at Pittsburg, Cal., will furnish 13,000 feet of redwood stave-pipe having a diameter of 60 inches, for the Southern Sierras Power Company's Plant No. 3 at Bishop Creek, Inyo County.

The Hull-Chaney Electrical Company and the Chehalis Electrical Works, both of which have conducted offices in Chehalis, Washington, have been consolidated and will hereafter be known as the Chehalis Electrical Company. The stocks of both companies have been moved into the Geissler building at the corner of Market street and Pacific avenue.

The Pelton Water Wheel Company has been awarded a contract by the Ophir Hill Consolidated Mining Company at Ophir Hill, Utah, for two 300-kw. Pelton-Doble tangential water wheels operating at 600 r.p.m under a head of 1100 feet. This installation is for use as a helper plant to work in parallel with two other Pelton hydroelectric plants supplying power for mining and commercial purposes. The new wheels will be direct-connected to Westinghouse generators.

The General Electric Company reports that the rating of the two 10,000-kw. generators recently ordered by the Great Western Power Company is as follows: Two 12,500 k.v.a., 1500 v., 400 r.p.m, 3 phase, 60 cycle generators, on vertical shafts, to be direct-connected to two I. P. Morris water wheels. A 500 kw., 250 v. exciter, direct-connected to an I. P. Morris water wheel and the switchboards are also included in the contract. Both generators are to be installed in the new extension of the Las Plumas power station at the Big Bend of the Feather River.

The Pelton Water Wheel Company has been awarded the contract for a large quantity of lap-welded steel piping for use in connection with the Los Angeles Aqueduct power developments. The pressure pipe will be manufactured in Germany by the Ferrum Pipe Company, for which the Pelton Company has the agency. Also a series of expansion joints and butterfly valves seven feet in diameter for use in connection with the San Francisquita Power Station No. 1, the water wheels for which are now being manufactured in the Pelton shops. The above pipe will be used to conduct water to three 14,000-h.p. wheels.

The Pacific Gas and Electric Company was the recipient of three prizes at the State Fair which recently closed at Sacramento. The company's elaborately equipped electrical demonstration car was run into the fair grounds and entered as an exhibit. It was in charge of E. A. Weymouth of the commercial department and a staff of assistants. The car itself was awarded a gold medal. A first premium award was given for the electrical exhibit of motors, fans, arc lamps and other apparatus. A gold medal was also awarded for the best exhibit of electrical appliances, such as cooking and heating devices, motors for household use, etc.

Among recent orders received by the Westinghouse Electric & Manufacturing Company, are the following: Oakland, Antioch & Eastern Railroad Company, San Francisco, Cal., for two 750 kw., 1300 volt d.c. 1080 h.p., 11,000 volt a.c. 3 phase, 60 cycle, 514 r.p.m. 2 bearing synchronous motor-generator sets, together with two 5 panel switchboards for the control of same. The Peninsular Railway Company, San Jose, Cal., for 8 quadruple equipments of No. 333B-2 motors designed for operation on 600-1200 volt circuits with A-L-F control. The Pacific Electric Company, Los Angeles, Cal., for 45 quadruple equipments of No. 333B-2 motors designed for operation on 600-1200 volt circuits with A-L-F control.

The most important order as regards size, capacity and high duty, ever placed for hydroelectric development was closed by George Henry, Jr., last week at Los Angeles, for the Big Creek development of the Pacific Light & Power Corporation. The order consists of more than seven million pounds of lap-welded pipe, running down to a thickness of 1.42 in., for a static head of over 2,000 feet. The lower portion of this pressure pipe is to have flanges welded on while the upper portion will consist of sections joined by rolled hump-joints of special design. The pipe will be put together completely in the shop, every section being matched and marked, including all the elbows and wyes, which are also to be made of welded material throughout. Deliveries are to commence in ten weeks and to be completed early next spring.

OREGON ELECTRICAL CONTRACTORS' ASSOCIATION.

For the last eight months the association have received on an average of four members each month. At this rate all the legitimate contractors in Oregon will have their names on the roll in six months' time. One of their principal objects is to co-operate with the electrical inspectors throughout the state to raise the standard of electrical installations. They also have in contemplation the presentation of a state license law for electrical contractors along the lines that have been adopted by other states and found satisfactory to all concerned. The officers are: J. H. Ralston, Albany, president; W. O. Fouch, Portland, vice-president; J. E. Kilkenny, St. Johns, secretary; J. R. Tomlinson, Portland, treasurer.

NEWS NOTES

INCORPORATIONS.

ONTARIO, CAL.—Articles of incorporation have been filed for the Granger-Hall Electric Company of Upland. The company is capitalized for $20,000. Subscribed by E. H. Granger, Violet Hall and A. J. Hall.

CHEHALIS, WASH.—Articles have been filed in Salem, Ore., by the Washington Electric Railway Corporation, organized at Portland for the purpose of constructing an electric line from Tacoma to Vancouver, Wash. The incorporators named are R. B. Montague and Chas. Berryman of Portland and H. C. Coffman of this place. Capital, $1,000,000.

ILLUMINATION.

NEHALEM, ORE.—Chas. Foster has submitted an application for a 30-year lighting franchise.

LA GRANDE, ORE.—Cluster lights are soon to be installed in the business part of the city.

PULLMAN, WASH.—The Idaho-Washington Light & Power Company is negotiating with the business men for the establishment of cluster lights in the city.

MOSCOW, IDAHO—A. W. Tyler of this place has purchased the Troy electric light plant and is planning the construction of a power line from here to Troy.

REDLANDS, CAL.—The city trustees have sold the $600,000 municipal water bonds to Torrance Marshall Company, of Los Angeles, receiving a premium of $17,552.

WICKENBURG, ARIZ.—The sale of the electric light and power plant of the Central Arizona Electric Company, which was to occur on September 12, has been postponed to October 7.

MERRITT, B. C.—The city fathers have awarded the contract for the construction of the power house for the combined city lighting plant and pumping station to Fowler & Larson at $3200.

BREMERTON, WASH.—The city council has decided to begin work at once on plans to secure a municipal lighting plant and distributing system for Bremerton. Estimated cost, $25,000.

DEER PARK, WASH.—William Binter and Frank Spinning of Spokane have purchased the interests of George Nixon in the Little Spokane Power Company at this place and will rehabilitate the same, adding new poles, wires, etc.

SAN FERNANDO, CAL.—Surveyors in the employ of the Pacific Light & Power Company are running a preliminary line around the eastern edge of the valley. This line, it is reported, will take the place of the high voltage Kern River line.

MONROVIA, CAL.—Recently the Southern Counties Gas Company spent about $25,000 in enlargment of its plant and improving its distributing system, and announcing that it is its intention to add still more improvement to the Monrovia plant at an early date.

SEATTLE, WASH.—The Colman Dock Company will equip its tower station with a powerful red and white flashlight and an automatic fog bell. A clock 10 ft. in diameter marked by letters 14 in. high will also be installed. The above named improvements will fill a long felt want among seafaring men.

GLENDALE, CAL.—The municipal light department has taken over the electric light line leading to Verdugo Park from the Glendale Electric Railway Company. The purchase money will be used by the railway company in removing trolley wire poles from Broadway.

TRANSPORTATION.

OREGON CITY, ORE.—Early extension of the Mount Hood division of the Portland Railway, Light & Power Company line from Cottrell, which is near the present terminus, to Sandy, is virtually assured, according to the report of Edward F. Bruns, secretary of the Sandy Land Company.

LOS ANGELES, CAL.—Mayor George Alexander broke ground for the municipal railroad to the Los Angeles harbor on September 19, the date on which the city's option on right of way secured at this spot would have expired unless ground had been broken.

MONTEREY, CAL.—The Pacific Grove & Monterey Railway Company has made application to the city council for a 50-year franchise to construct and maintain a single or double track street railroad. Sealed bids will be received up to October 15th, for the sale of said franchise.

LAKEPORT, CAL.—Work on the Clear Lake Railroad, which is being built from Hopland, Mendocino County, to the towns around Clear Lake, is in progress. Seven miles of the road bed is practically complete, but a big cut, in which a steam shovel is working, is only about 20 per cent complete. This cut is the heaviest piece of work excepting the tunnel at the summit.

EASTON, CAL.—Ansel M. Easton has entered into a contract with Mahoney Bros. for the immediate construction of an electric road, which will be several miles in length. It will run from the Easton Hills to the Easton Station and connect with the suburban lines of the United Railroads. The cost of the line, with its power houses and rolling stock, will be about $75,000. The Supervisors of San Mateo County granted the franchise some time ago.

SAN FRANCISCO, CAL.—The Railroad Commission has rescinded its order of June 29, permitting the Tidewater & Southern Railway to issue $750,000 in bonds and $3,500,000 in stock, upon the alleged ground that the Tidewater & Southern is paying commissions at an unauthorized rate upon the sale of its stock. This is the first case in which the commission has taken such action. The question involved will probably be fought out in the courts.

SAN FRANCISCO, CAL.—The Anglo-California Trust Company is named as trustee of the security offered by the United Railroads for $300,000 of 6 per cent notes, the proceeds of which, together with $74,000 to be supplied by the company, will be used for the purchase of 65 new cars. The notes will be retired at the rate of $30,000 annually. The cars will be purchased by the trustees, in whom the title vests. The company agrees to keep the cars insured against fire and earthquake up to the par value of the security.

SAN DIEGO, CAL.—The Los Angeles & San Diego Beach Railway Company has filed an application with the Railroad Commission for a rehearing of the case in which it was recently directed to lower certain of its commutation rates. The rates which the commission ordered reduced applied to that portion of the line between San Diego Beach and La Jolla. In asking for a rehearing the Los Angeles and San Diego Beach Railway Company objects to the rates as fixed by the commission and to rules of service as fixed by the commission.

LOS ANGELES, CAL.—Relative to the application of the Pacific Electric Railway Co. of Los Angeles for permission to dispose of its unsold treasury bonds, amounting to $79,161,000, the company has an authorized issue of $100,000,000 of stock. Of this amount $74,000,000 has been issued, of which $73,950,000 is owned by the Southern Pacific Company. The direc-

tors of the Pacific company recently authorized a total bond issue of $100,000,000. Of this sum, $20,839,000 has been issued. Of the remaining $79,161,000 the sum of $31,511,000 is reserved for refunding outstanding obligations of the subsidiary lines. The remaining $47,650,000 will be used for new construction, improvements and extensions as the needs of the company require. The application is made by the company in three divisions. The first is for permission to issue $5,528,000 of the refunding bonds for the purpose of retiring the outstanding bonds of the Los Angeles Interurban Company and the Los Angeles & Redondo Railway Company. The second division of the application asks for permission to issue in the amount of $26,226,000 for the purpose of refunding all other outstanding obligations. The third division asks permission to issue the remaining $74,650,000 without specifying in detail for what purposes they are intended.

TRANSMISSION.

GRANGEVILLE, IDAHO.—The Rapid River Mining & Milling Company has taken up a power site and contemplates development of same.

CALDWELL, IDAHO.—The Idaho-Oregon Light & Power Company will start construction work at once on a $75,000 depot and substation at this place.

BUHL, IDAHO.—I. B. Perrine has made a proposition to C. H. Taylor, E. A. Milner et al., of this city, to build an electric line out of Buhl through Castleford to the Salmon River.

EVERETT, WASH.—The county commissioners have granted a 25-year franchise to the Sultan Electric Company to erect a pole line along the E. M. Taylor and the Monroe-Sultan roads.

MIAMI, ARIZ.—The Inspiration Consolidation Company has made a contract with the United States reclamation service to take 7500 kw. of electric power from Roosevelt dam. about 40 miles distant, and a survey for the transmission line has been made.

VALLEJO, CAL.—The bids for the furnishing of power for the pumping operations at Lake Chabot were opened yesterday, and it was found there was but one bidder, the Great Western Power Company to whom the contract was awarded on its bid of 2c per kw.-hr. for 75,000 kw.-hrs.

SUNOL, CAL.—Work has been commenced by the Livermore Water & Power Company on a new line from Livermore to this place, and within a few weeks local residents will be supplied with electric power for domestic and business purposes. The building of this line is the result of negotiations extending over several months between citizens of Sunol and officials of the company.

SALEM, ORE.—The State engineer has approved an application of Geo. T. Holcomb to appropriate 1000 second feet of the waters of Clackamas River for power purposes. The permit covers 15,000 h.p. Recently the application of D. P. Donovan of Payette, Idaho, for use of the Clackamas for generating 15,000 h.p. was approved. These two proposed plans, with the Cazadero and River Mills plants of the Portland Railroad, Light & Power Company, aggregate 116,000 h.p.

SAN FRANCISCO, CAL.—The State Railroad Commission has authorized the issuance by the Pacific Gas & Electric Company of $5,000,000 of general and refunding 5 per cent bonds for the purpose of constructing a 55,000 h.p. hydroelectric plant on the Bear River and the installing of a new double circuit steel tower line to the center of the company's system. The bonds have been secured by J. P. Morgan & Company at 85, and will be handled in the East by N. W. Harris & Company, and locally by N. W. Halsey & Company. The project will enable the company to dispense with some 26,000 h.p. which it is now purchasing, effecting a saving of approximately $160,000 yearly after defraying interest and maintenance charges. The plan contemplates the ultimate development on Bear River of 100,000 h.p.

TELEPHONE AND TELEGRAPH.

DOUGLAS, ARIZ.—The telephone system of this city is to be reconstructed.

SHELTON, WASH.—The Harstino Telegraph Company has made application for a franchise in Mason County.

LYMAN, WASH.—The Skagit River Telephone & Telegraph Company has been granted a franchise to operate in the town.

VERNON, B. C.—The Okanogan Telephone Company contemplates the expenditure of $200,000 down the lake and vicinity, in extensions, etc.

TEKOA, WASH.—Mr. Anderson has been granted a telephone franchise here. He purchased the interest of the Pacific Telephone & Telegraph Company.

COVINA, CAL.—The Railroad Commission has granted permission to the Home Telephone Company of Covina to issue 369 shares of common stock.

SANTA BARBARA, CAL.—The Pacific Telegraph & Telephone Company has started work removing its wires from State street. The cost will be about $20,000.

EATONVILLE, WASH.—The forestry service will build more than 40 miles of trails and telephone lines in the Rainier national park. The sum of $5000 is available for that purpose.

EL PASO, TEX.—The Tri-State Telephone Company has been granted a franchise to erect poles and string wires along the easterly edge of Donaphin's drive from the Santa Fe crossing to the New Mexico line.

ALBUQUERQUE, N. M.—The Western Union Telegraph Company is to maintain an overland repeater station here which will probably become one of the most important between Los Angeles and Chicago and San Francisco. A dynamo plant will be installed together with extensive repeater equipment.

PORTLAND, ORE.—The engineering department of the Pacific Telephone & Telegraph Company has awarded a contract for the excavating, concrete foundation work and concrete footings for the 14-story class-A building which is to be erected in Portland, to the Sound Construction & Engineering Company, of Seattle.

SAN FRANCISCO, CAL.—The Pacific Telephone & Telegraph Company has been granted permission to lay a new telephone cable across the bay. The cable as planned is said to be one of the largest in the world, and is being laid because the company expects the new reduced rate to increase its transbay business. Since the company reduced its rate on September 1 from 15c to 10c, the number of daily calls has increased 9 per cent. Previously, the average number of calls per day was 9096, these including calls between Oakland, Alameda and this city. For the first twelve days of September the average per day has been 9840 calls. Under the old rate, the company's gross revenue daily from the transbay service was $1364.40. The average gross revenue per day since the new rates were put in is $984, or a decrease of $380.40.

WATERWORKS.

SANTA ANA, CAL.—Work on the municipal water plant at Fullerton will begin about October 1. Bonds were recently voted for $30,000 for this purpose.

AMERICAN FALLS, IDAHO—The contract for the completion of the dam at this place for the purpose of generating 30,000 h.p. has been let to the James H. Greene Construction Company by James A. Brady. The dam will be 1200 feet in length and will require 16,000 yards of concrete.

LOS ANGELES, CAL.—One of the largest contracts ever awarded a foreign power in the West was won by Germany from this city September 13. From far-off Kattowitz, Upper Silesia, two miles of welded high-pressure pipe, weighing more than 2000 tons, and costing more than $250,000 is to be brought to Los Angeles to be used to carry the great flow of water to Power Plant No. 1.

ALPHABETICAL INDEX TO ADVERTISERS

JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

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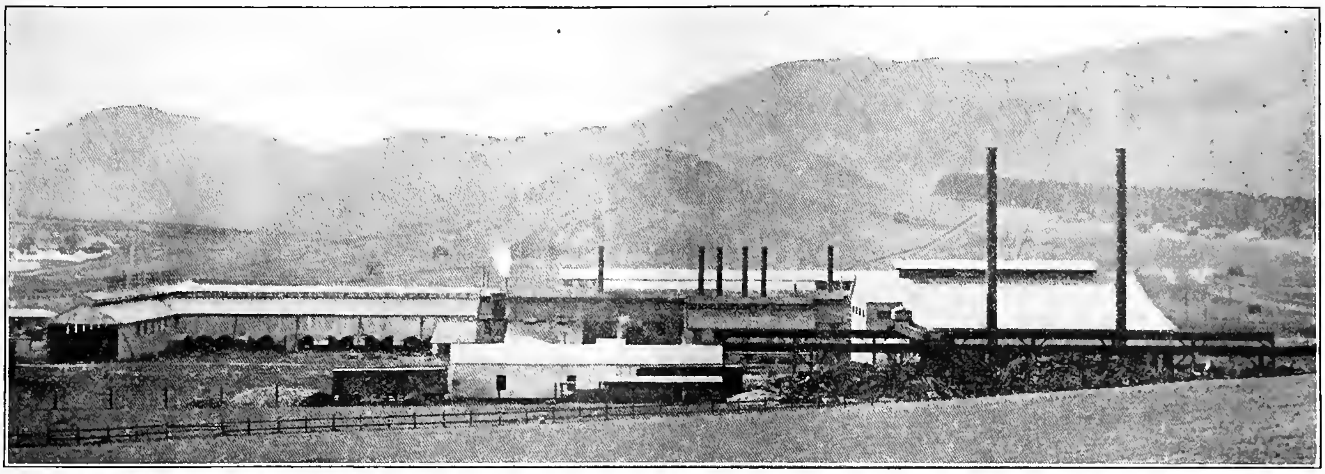


View of Plant from the East; Furnace Building and Raw Material Yard on the Right; Rolling Mill and Boiler House in Center Background.

PACIFIC COAST STEEL CO.'S SAN FRANCISCO PLANT

BY RUDOLPH W. VAN NORDEN.
Member A. I. E. E., A. S. C. E.

We have become so used to the thought of sending to the Eastern markets or abroad for structural iron and steel, that it is hard to realize that California has within its gates the materials, the fuel, the power, the capital and the conditions for the manufacture of these products. San Francisco has not been the center of manufacture that is the right of one of the greatest and most important seaports in the world, chiefly on account of the labor conditions and former lack of cheap fuel. The previous apathy is being gradually overcome, capital is discovering that there is a need for home industries, and the unequalled supply of electric energy, as well as fuel oil, is now contributing its influence in bettering conditions.

The Pacific Coast Steel Company is a pioneer in the manufacture of high grade mild steel for building materials,—reinforcing bars and structural shapes. Its construction of a modern plant at South San Francisco was a daring experiment that required faith in the future of the local market. The success of the venture now seems assured. It was realized that a market for this material would be in constant and close competition with products imported into the domestic field and that the success of the plant would rest largely on the care of manufacture and the high grade of the product. The plant was therefore designed and built to this end. The process of manufacture is that known as the "basic" in which the mixture, in distinction to the "acid" process, contains a lower percentage of impurities,—phosphorus, sulphur, etc., and results in a tougher, more easily worked metal which can be bent cold and has a high resistance to shocks and strains. Siemens-Martin "open-hearth" furnaces are used and the smelting in these furnaces is practically the first movement toward the finished product.

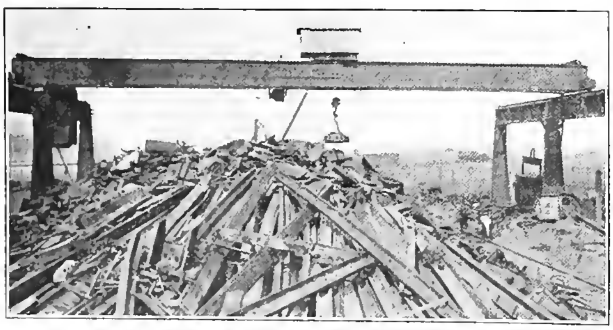
A look at the material pile from which the product is manufactured would give the uninformed person the impression that anything in the nature of scrap iron was used. This is not the case, however. The greatest care in the selection of junk is employed and is indeed necessary, because every batch from the "melt" must contain certain ingredients in proper proportions, otherwise the finished product would not meet specifications or stand the tests. The scrap pile consists of steel rails, old cables, old structural steel, dredger buckets and all sorts of old steel plates and castings. This junk is broken to a size which will enter the furnaces and when the charge is made a certain amount of pig iron, California iron ore and other materials, including quartz flux and limestone,

are added to give the proper chemical and mechanical constituency.

The following is an analysis of elements other than iron, from a test piece, taken from the melt before it is cast into ingots from which cold twisted reinforcing bars are to be made:

Carbon	0.19 to 0.24 per cent
Manganese	0.45 to 0.55 per cent
Phosphorus	up to 0.06 per cent
Sulphur	0.04 to 0.05 per cent

The charge is placed evenly over the bed of the furnace which is already heated to the proper temperature. The Siemens-Martin furnace consists of a hearth or bowl shaped bed which is completely covered with an oval roof of fire resisting material. At both ends of the hearth are openings into rectangular chambers which extend down lower than the hearth and at the bottom of these chambers are openings into the chimney flue through which the products of combustion are carried into the high steel stacks. These chambers are filled with fire brick known as checkerwork, and laid as the name would suggest to give spaces between the bricks. There are dampers in the chimney flues which work automatically so that when one is open the other is closed. The checkerwork chambers give the reverbatory action as follows: The flame from the oil burner at one end of the furnace plays over the bath of metal. Air is introduced under pressure through the checkerwork of the chamber closed to the chimney. The checkerwork from the previous blast in the opposite direction being already at a high temperature, the incoming air picks up this stored heat which is carried over the bath and imparts heat thereto. It then passes through the other checkerwork to which it gives up its remaining heat and thus brings these bricks to a high temperature. After this action has taken place for a certain time, the dampers and drafts are reversed and the process repeated in the opposite direction.



Raw Material Yard; Crane and Lifting Magnet.

When the metal is thoroughly melted and is found by test to be the correct mixture, it is drawn into a giant ladle holding the entire charge of the furnace, this ladle having been previously heated on the inside to prevent chilling of the charge. The ladle is lifted and moved to any place on the foundry floor by two travelling cranes and the metal is poured into molds. These have the appearance of old-fashioned cannon and are cast iron tubes which contain the sand mold for the ingot. The molds are placed on end in a long pit, there being six in each group, side by side, which are poured at once, connection between the molds being at the bottom. These ingots are known as, "bottom poured ingots." The ingot is a solid rectangular chunk of steel, 8 in. square and about 5½ ft. long. They are piled nearby until sufficiently cool when they are transferred to the reheating furnaces preparatory to rolling into the final shapes. The travelling crane loads the ingots in groups of six to a car which conveys them to the reheating furnace. They are then fed through a door in the end of this furnace, being placed cross-wise to the furnace. The latter is long and narrow, the hearth slanting toward the lower end whence the ingots are removed. Loading is done with a hydraulic lift which automatically opens the furnace door as it shoves the ingot in. The furnace holds 40 ingots which accumulate heat as they travel toward the outlet. The hot ingot is removed by a conveyor which places it at any point desired in the rolls, imparting the start necessary to have the rolls take hold. After passing back and forth through the rolls until a certain size is reached, the ingot, now a billet, is cut off at a proper length to give the specified length of the finished shape. This is done in a shears. The billet is now reheated in a second reheating furnace if necessary, or it is passed directly through the 10 in. finishing rolls which impart the desired shape. The finished bars are now taken on a conveyor to the hot table where they are straightened and cut and finally twisted if this form is necessary.

In placing material of this sort on the market a superior grade of metal is necessary, as before stated. Especially true is this of rails, twisted and deformed bars. Steel made by the open-hearth process possess the advantages necessary for cold twisting and bending. By other processes a steel of higher tensile strength may be had, but possessing a lower bending moment. Square bars are twisted cold and this results in raising the tensile strength.

The rolling mill is in reality in two parts. The heavy 18 in. ingot rolls handle the tie-plates, rails and structural shapes which travel to the north end of the mill. The smaller 10 in. finishing rolls make the square and deformed reinforcing bars and these travel to the opposite end of the mill. It is therefore possible to manufacture both types of material at once.

This plant is designed to be operated throughout with electricity. All mechanical movements are to be made with motor drive with the exception of the hoists which charge the furnaces. At present the principal machines where power is required, the rolls, are driven by cross compound steam engines, these are however soon to be replaced with variable speed, heavy-duty induction motors. At the time this plant was built it was found impossible to obtain a sufficient amount of power for the work and the engines were installed as a temporary expedient. All of the motors so far installed are direct current shunt wound machines and operate at 250 volts. This current is generated by two 50 kw. sets each driven by a single non-condensing engine. In anticipation of the power soon to be received from one of the transmission power companies, there has been installed a two-phase rotary converter with the necessary transformer and switchboard equipment. The mill motors will operate directly from the 10,000 volt three-phase supply.

Description of Motor Equipment.

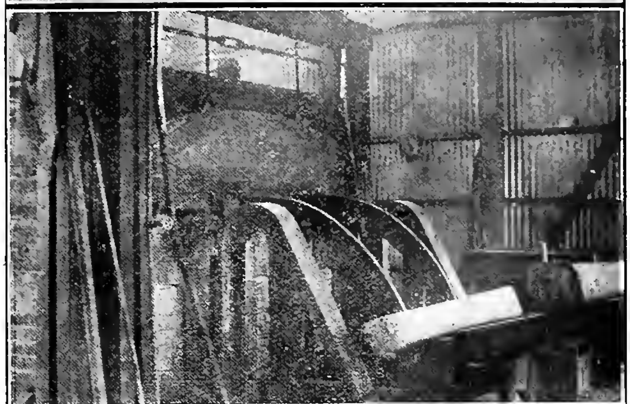
The scrap or raw material yard is spanned by a travelling crane. The crane rails are heavy girders mounted on two rows of buttressed columns which give the crane a clearance above the ground of 24 ft. The span is 75 ft., and throughout this span are the piles of scrap iron and steel to be used as needed. Space is left for a railroad track under the span and parallel to the direction of travel. The crane is electrically operated throughout, having a 21 h.p. motor on the bridge, a 5 h.p. racking motor and a 21 h.p. motor on the hoist which has a capacity of 25 tons. In lifting the raw material from the cars to the piles, a 43 in., 3 ton Cutler-Hammer lifting magnet is used. This is energized from the 250 volt motor circuit.

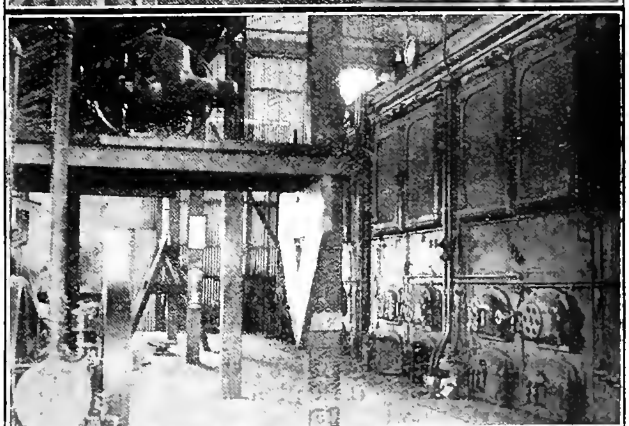
There is to be installed a motor operated charging machine, the various movements of which will be actuated by one 21 h.p., two 8½ h.p., and one 3½ h.p. direct current motors. This machine, equipped with variable speed controllers, which is built of heavy structural steel shapes, will travel along the charging platform on a track and its duty is to pick up a steel hopper in which the raw material has been piled, carry the hopper to the proper furnace door, shove it into the furnace, emptying the charge by a half turn of the charging head and withdrawing the empty hopper. With the charging machine it will be possible to make three eight-hour heats of the furnace each day. With the present method it requires seven hours to charge by manual labor.

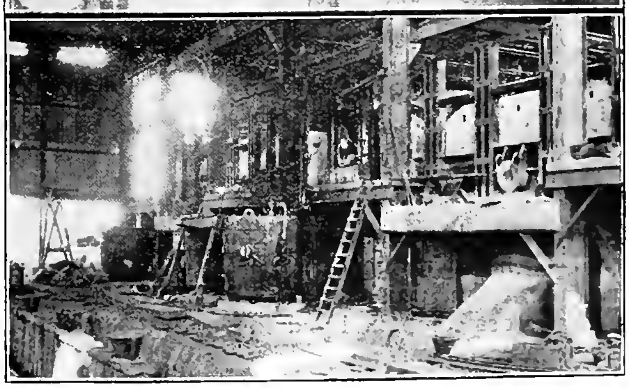
California crude petroleum is supplied through Tait & Jones burners with the aid of a air jet. The oil and air are controlled from a stand at the outer edge of the charging floor.

The open-hearth furnaces are lined on the sides and top with a silica brick to withstand a temperature of about 3500 degrees Fahrenheit. The checkerwork also has this brick but the hearth on which the bath rests is of magnesite brick. It requires eight to nine days to bring the furnace to the proper heat for operation and then the magnesite bottom must be set to put in condition for the molten bath. It is possible to run, where oil firing is used, about 340 heats before it is necessary to reline the furnace. Where producer gas is used for heating, only about one-half the number of heats can be made. From the time of charging to that of pouring requires less than eight hours. A charge weighs about 25 tons. The furnaces and charging platform occupy about one-half of the building longitudinally, which like all of the buildings is of steel and corrugated iron and is 121 ft. long and 90 ft. wide. The other half is the casting floor where the ingots are made. There are two travelling cranes, the one a Case double crane has two hoists of 30 and 5 tons. This crane is driven by direct current motors as follows: One 25 h.p. bridge motor, one 25 h.p. and one 15 h.p. on the respective hoists and two racking motors of 7½ and 5 h.p. The other crane used for stripping the molds has a capacity of 10 tons. It is driven by three motors of 13 h.p. for the bridge, 10 h.p. on the hoist and an 8½ h.p. racking motor.

The boiler house, a building 40 ft. x 70 ft., adjoins the rolling mill building and is equipped with four 280 h.p. Babcock & Wilcox boilers in two batteries. These supply steam for all the uses about the plant. On the main floor is a Gardner air compressor, belt driven through a countershaft by a 15 h.p. direct current motor. This supplies air for the furnaces. In the pit at one side of the boiler house is a combination vacuum and circulating beam pump and a surface condenser which operate on the exhaust from the large engines, although these are generally operated non-condensing. There is also a Dow three-throw plunger







Open Hearth Furnaces and Charging Floor.
Ingots and Hydraulic Lift Charging Re-Heating Furnace.
Babcock & Wilcox Boilers and Air Compressor.
25-Ton Ladles and Ingot Casting Floor.

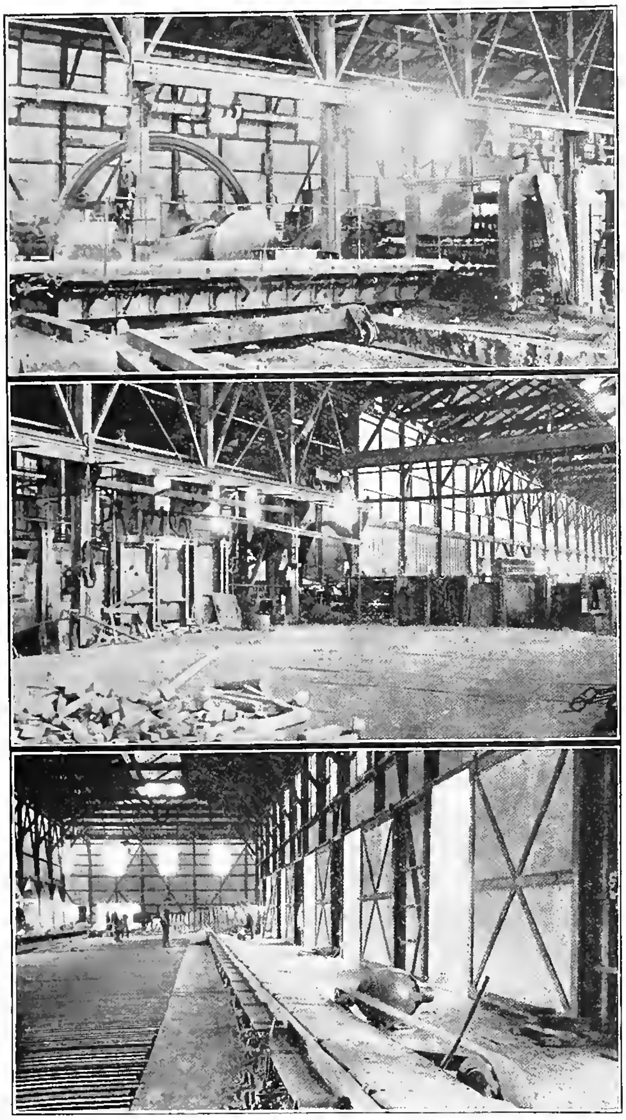


Table for Charging Ingot Rolls; Rolls on Right.
A Re-Heating Furnace (Left); Finishing Rolls (Right).
Hot Table Showing Motor Driven Conveyors.

pump driven by a 15 h.p. direct current motor which supplies water under pressure for various uses about the plant. A 23-ton floating pressure equalizer maintains a constant pressure on this system which operates at 400 lb. per sq. in.

The rolling-mill engines were built by the Union Iron Works and are similar, the one driving the 18 in. ingot rolls has a rating of 900 h.p.; the other which drives the 10 in. finishing rolls is rated at 350 h.p. They are cross compound and condensing.

The present current supply is from two 50 kw. multipolar direct current generators, the one being direct connected to a 100 h.p. tandem compound Ideal engine operating at 300 r.p.m., the other is driven through belt and pulley by a Erie City 75 h.p. simple engine. A 6 panel switchboard mounts two main generator knife switches and 12 switches for the various motor circuits.

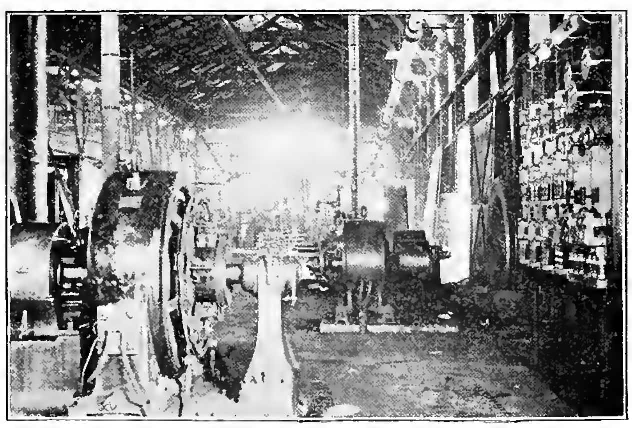
The three-phase, 10,000 volt current supply recently installed is brought into the building to two 100 kw. oil-immersed and air cooled Westinghouse transformers, having Scott three-phase to two-phase connection and these have a secondary potential of 176 volts for supply to the rotary converter. The rotary is a Westinghouse 250 kw. operating at 514 r.p.m. and will supply current at 250 volts for all of the motors in the plant except the mill motors which will displace the engine driven sets. The switchboard is a Westinghouse white marble in three panels with instruments and circuit-breakers for the rotary-converter and the 10,000 volt lines.

After leaving the rolls, a bar is carried to the desired place on the hot table by a roller conveyor. This consists of horizontal rolls 8 in. diameter, spaced 4 ft. apart, and on their shafts are pulleys over each of which a belt runs. This belt is driven from a countershaft by a 5 h.p. motor, there being three of these sets. A 10 h.p. motor drives a finishing shears at the end of the hot table, these will cut cold steel up to 1¾ in. diameter. At the end of the hot table for the ingot rolls is a shears driven by a 25 h.p. motor which will cut cold steel up to 2 in. x 6 in.

The billet shears, which cut off the hot billets coming from the ingot rolls, will cut up to 4 in. square. This shears is driven by a 15 h.p. motor.

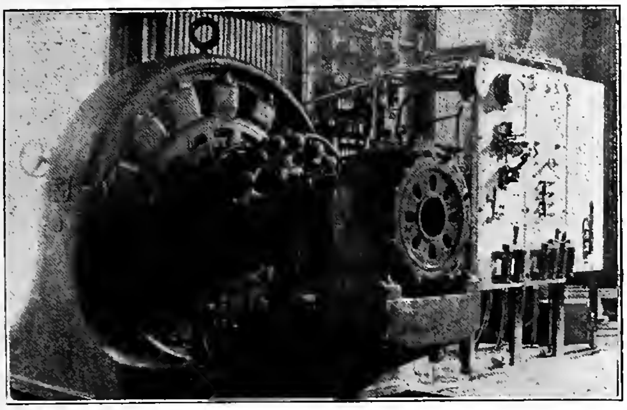
The machine, or "table," which delivers a billet to the rolls has three motors. This table has three motions. On its surface is a set of rollers which move the billet forward or backward driven by a 12.5 h.p. motor equipped with a magnetic brake. The bed of the table is tilted to meet the upper or lower rolls by a motor of 12.5 h.p. and the whole mechanism moves across the face of the rolls as a transfer table and is driven by a third motor of the same size as the others. Three variable speed controllers are mounted at one side of the machine where the attendant can see all operations.

When twisted bars are required they are taken from stock in the building at the end of the hot tables. The twisting machine is a simple affair. A 12.5 h.p. induction motor is belted through a countershaft, to give the correct speed to a spindle which is geared to two spindles which operate in opposite directions. These have at the end of their short shafts, sockets with a square opening in which fits a chuck, the latter being of the right size to take the bar to be twisted. The bars, which are square, are placed one end in the chuck and the other in a movable vise and the motor is started and stopped when the proper number of turns has been given to the bar. If there is any imperfection either in the chemical or physical property of the bar or in the mechanical formation, it will show under this twisting test.



Direct Current 50 kw. Generators and Switchboard.

The rolling mill building including the space occupied by the engines and electric generators is 500 ft. long and 80 ft. wide. At the south end is a shipping room wing 110 ft. x 200 ft., and at the north end a similar wing 40 ft. x 200 ft.



250 kw. Rotary Converter and Switchboard.

The remaining buildings are a storehouse which will hold 5000 tons of finished product; a tool and supply house and a laboratory.

Much of the machinery and equipment of this plant was built on the ground by the company's engineers and there is a shop equipped with the necessary tools for replacing gears, rolls and other important parts.

LIGHTNING IN RELATION TO FOREST FIRES.

Transmission companies operating across the national forests will be interested in the summary of conclusions brought out by an exhaustive research into lightning discharges recently brought to a close of the department of agriculture and set forth in forest service bulletin No. 111. The superstition of centuries that certain species of trees are struck most by lightning is seen to be up-rooted. The summary of conclusions shows:

1. Trees are the objects most often struck by lightning because: (a) They are the most numerous of all objects: (b) as a part of the ground they extend upward and shorten the distance to a cloud; (c) their spreading branches in the air and spreading roots in the ground present the ideal form for conducting an electrical discharge to the earth.

2. Any kind of tree is likely to be struck by lightning.

3. The greatest number struck in any locality will be of the dominant species.

4. The likelihood of a tree being struck by lightning is increased: (a) If it is taller than surrounding trees; (b) if it is isolated; (c) if it is upon high ground; (d) if it is well (deeply) rooted; (e) if it is the best conductor at the moment of the flash; that is, if temporporary conditions, such as being wet by rain, transform it for the time from a poor conductor to a good one.

5. Lightning may bring about a forest fire by igniting the tree itself, or the humus at its base. Most forest fires caused by lightning probably start in the humus.

SHOULD GAS COMPANIES ENGAGE IN THE SALE OF APPLIANCES.[1]

BY L. H. NEWBERT AND H. P. PITTS.

The introduction, from time to time, of improved gas consuming appliances has been an important factor in the gas world, and has had a very beneficial effect on the business, and, as the prosperity of gas companies depends altogether upon the use of gas consuming appliances by their customers, the question of how best to increase and promote the sale of such appliances is one of utmost importance and brings us to the subject of this paper—"Should Gas Companies Engage in the Sale of Gas Appliances."

The question was recently put to an appliance dealer in a large city, and he promptly replied "no," and gave substantially the following reasons to justify his reply: "A company organized to supply gas should confine its operations to its manufacture and distribution, and should co-operate with dealers in the matter of the sale of appliances for both light and fuel purposes, particularly fuel. He argued that competition was the life of trade, and that if gas companies sold appliances there would be no competition, unless there should be more than one company in the field, and such is very seldom the case. He called attention to the fact that in the city in question the gas company does not handle appliances except for lighting, and then only to a limited extent, with the result that nearly all the retail hardware stores and many furniture stores, and some purely appliance stores, were selling appliances, each having an active selling force constantly in the field, with the result that the gas company was getting what it was properly entitled to, i.e., increased gas sales, and the dealers getting the appliance business, all of which was admitted to a certain degree; but, do all users of gas obtain thoroughly satisfactory appliances was asked. The dealer thought they did, as he called attention to the fact that he carried only well known reliable makes of ranges, water heaters, etc., which he sold at what he thought a fair price, i.e., a price which allowed a profit of about 33 1/3 per cent, including delivery and connecting.

The writers admit that the matter of the sale of appliances is not a one-sided question, and that there is merit in the argument of the dealer quoted. True co-operation between gas companies and dealers is, in theory, ideal, but can it be accomplished? Will the dealers, for instance, endeavor to sell a gas range yielding a profit of, say $5, whereas a coal or wood range might be sold and yield a profit of $10, and, again, will a dealer try to persuade a prospective purchaser to buy a gas range when a plate is desired? Some perhaps would while others would not.

One of the writers had occasion some time since to discuss with several dealers in a certain city the question of the sale of gas appliances. The gas company had, for several years, discontinued handling appliances, but because of the unsatisfactory increase in gas sales had announced that, at the expiration of three months, it would re-engage in the sale of appliances. The dealers protested, claiming that they had actively pushed the sale of gas appliances and had co-operated with the company in every possible way.

[1]Paper presented before Pacific Coast Gas Association, Sept. 18-20, 1912.

and, if the company should re-engage in the appliance business, that they would suffer a considerable loss. Their attention was called to the fact that the gas company had, during the previous year, turned over, as the result of canvasses made, more than 300 prospects for ranges and water heaters, and that only about 65 sales had resulted, which was considered a poor showing, and did not indicate active work or hearty co-operation on the part of the dealers. The gas company did resume the sale of appliances, and for the year ending June 30th, 1912, sold 626 appliances.

Gas companies want to sell gas; they want to increase their annual sales, therefore, should they not give the most serious consideration to the introduction of gas consuming appliances on their distributing system, and are they not almost justified, not only in installing without charge, but in addition thereto, furnishing appliances of certain types free? Would not the increase in the use of appliances justify such a course? We believe the question worthy of consideration. Take for instance, a hotel range costing, installed, in the neighborhood of $200. Thirty dollars per month is a conservative estimate of the consumption of gas, or an annual return of $360. Would not this be considered good business? Yet how many gas companies provide appliances free? And what is true in the case of the hotel range is equally true of other appliances, particularly industrial, and this brings us to another phase of the question, which is entitled to more than passing notice.

The introduction of industrial appliances is today attracting the attention of every gas company, and has opened a new field for the sale of gas, especially on the Pacific Coast. How many appliance dealers are giving any attention to this feature of the gas business? And how many are qualified to do so? None we venture to say in nine cities out of ten. This being the case, is it not absolutely necessary, and does not good business procedure require that gas companies handle industrial appliances, and, if so, why not all kinds of appliances?

The policy of the gas company should be that it is not only selling that commodity known as "gas," but that it is selling "service." The mere matter of an exchange of money for a certain number of cubic feet of gas, which the consumer may have used, is not the only item of consideration in the operation of the business department of the gas company. What it wants to deliver is not only the raw material, but the finished product, and this finished product may be summed up in one word—"service," so that to be consistent with itself and with the consumer it would show courtesy and truth in taking the order, promptness and dispatch in delivery, cleanliness and speed in making connections, and prompt attention in the maintenance of the appliance, and right here in the last clause is the keynote of "service." And how, may we ask, is this service to be rendered, if the gas company is not in a position to furnish each and every item which goes to make up the "service."

Leaving out of consideration all question of policy in the matter of co-operation with dealers in order to secure their good will, is it not but fair on the part of the gas companies in dealing with their consumers to furnish them with appliances at a very reasonable figure, if not at cost, or even less than cost. Is not the consumer entitled to this consideration? Is it not a factor in the business that gas companies should give more than passing notice? What more can gas companies do in addition to furnishing good gas than to provide their consumers with the opportunity of obtaining good reliable appliances—appliances that will give proper service and materially aid the company in furnishing consumers what they are entitled to, namely, "perfect service"?

Public service corporations are today, more than ever, endeavoring to retain the good will of the general public, and are spending time and much money to accomplish this end. Will not the supplying of appliances on liberal terms, more liberal than the dealer can afford to offer, and at prices which the dealer cannot approach, do much to bring about that condition of affairs so much desired,—absolute confidence between gas companies and their consumers

A gas company handling appliances puts itself in the position of protector to the consumer as well as of itself. In order to substantiate the contention that they should deal in appliances the following reasons are given:

First—Having sufficient capital to properly equip an appliance store, to give liberal terms and sell on a close margin, giving the consumer benefits impossible to be obtained from the small dealer.

Second—The gas company can well afford to stand back of and maintain appliances sold, keeping appliances in first-class shape and assuring a constant revenue from satisfied customers.

Third—By selling only appliances of high efficiency complaints will be minimized, and more satisfied customers guaranteed.

Fourth—They will be in a position to classify appliances and force all dealers to handle good appliances and sell at consistent prices.

Fifth—It creates a closer relation between the company and the customer, besides demonstrating to the general public that the gas company has confidence in its products and appliances.

Sixth—Affords an opportunity of educating employes in the possibilities of gas as a fuel, developing good appliance salesmen, and perfecting the organization.

Seventh—For economic reasons. Why the necessity of a consumer making a contract for gas in one place and then going to an entirely different concern to purchase an appliance which is useless without the manufactured product? It is only a simple process of arithmetic to prove that "service" can be handled cheaper under one head than two.

Eighth—Last, but not least, for strictly business reasons in the way of increasing the daily output. An appliance store properly operated by the gas company should certainly maintain itself and pay interest on the investment. When they are showing increased sales of high class appliances and an increase in gas output each month, then they have an almost perfect organization. An organization to show a constant increase in business must work in harmony and with a constant aim in view.

OWNERSHIP OF PUBLIC UTILITIES.

BY JOHN B. MILLER.[1]

There are only two kinds of public utilities ownership—private ownership and public, or as it is more commonly called, municipal ownership. The public is entitled to expect the same treatment from either kind of ownership; that is, good service at the most reasonable rates with a liberal policy as to extensions. These three things depend upon:

First—An efficient, alert, and as near as may be, unchanging management and force of employes.

Second—The command of sufficient money at a not undue cost to promptly make needed extensions.

The only advantage which municipal ownership possesses over private ownership is that, in California at least, municipal bonds can be sold on a slightly lower interest basis than privately owned public utility bonds. Another advantage which it may be said to possess is that as a rule municipally owned plants are not operated for profit, which should enable them to make a somewhat lower rate than privately owned plants can do. There are, however, two sides to this question. By many it is maintained that this is not really an advantage, as money must be had for extensions and this money must be obtained by the sale of municipal bonds, so that the consumer and taxpayer make up the difference in the low rate by increased taxes.

This difference in the cost of money reflected in the average consumer's light bill is not over a few cents a month and the advantage of it is more than compensated by the likelihood under municipal ownership of the presence of certain evils extremely inimical to good service, economical management and prompt satisfaction of public demands for service and extensions. For instance, I state above that in order to bring the people what they are entitled to receive in the way of good service, etc., the management and the force of employes must be quite efficient and as long in tenure of service as possible. This is almost impossible to obtain under municipal ownership, because instead of alert, efficient business men being obtained for management, whose only idea is that of efficiency and devotion to duty, the manager and employes are more apt to be selected, either because of political influence or ability to manipulate the plant and its system in such a way as to make political capital for the mayor, common council, or other political backers behind them.

Again, it is most difficult for municipally owned plants to obtain help, or management of the highest order, because men of ability and experience much prefer employment with privately owned corporations, where their tenure depends solely upon their ability and loyalty, and in no respect upon their ability to do politics or influence votes.

Under municipal ownership as a rule plants are not operated for profit, or even if so, cannot be expected to earn but a moiety of the amount necessary to meet the demand for extensions, and there is great likelihood of stagnation. If the city or territory served by the municipally owned plant, grows after its first installation to a point where there is additional territory and consumers clamoring for extensions, these cannot be made except by the sale of bonds. Municipal ownership bonds must be voted by the people. The majority of the people concerned are already served with electricity, and to vote more bonds to run extensions to sparsely settled territory would mean for those who already enjoyed service only an additional tax. Consequently it has been the experience that under municipal ownership extensions are not made with nearly the liberality or promptness that exists under private ownership.

It has long been the opinion of the best thought on public utility matters that the people are best served by having the municipality own and control all utilities having to do with health and sanitation such as water, sewers, policing of streets, etc., but all other utilities calling for a more or less high degree of technical ability and the employment of a great many men, —such as transportation, telephone, telegraph, electric light, gas, etc., carrying the chance of hazard not only financially, but as to life and property, can best serve the people when privately owned and publicly regulated.

In order to give the people the best service and the lowest rates all public utilities should be natural monopolies.

As evidence of this you have simply to call to mind the situation where two competing telephone companies serve the same community. While the annoyance and cost is not relatively so great where two competing electric companies serve the same communities, it is almost as great because of their duplicate use of the streets and alleys, and it is just as great in case of a consolidation of the two companies (and this is almost always eventually the case) as interest must be earned upon a double investment and the cost almost invariably falls upon the consumer.

These companies should be properly regulated by a state board consisting of men chosen for the purpose, and if possible appointed for life or good behavior, but if not, for extremely long terms. Such appointments should carry good, high salaries, so as to command men of the very highest ability, intelligence and character. A state board should have full power to regulate rates, service and financing and no company should be allowed to establish business until it has obtained authority from the state board. We do not have this kind of regulation in California as yet. It is largely because this question of regulation is understood only by comparatively a few. This is principally our fault, as we who are more vitally interested than anybody else, have not been as enterprising and industrious as we should have been in the education of the rest of the community. With this kind of regulation in which the investor as well as the consumer is protected, and justice given to both, the business will take on a character of such greater stability as to enable it to obtain its money at substantially as low a rate as municipalities can do. When this condition obtains, as it is sure to do in time, private ownership under scientific public regulation will afford the most advantageous method of serving the people with public utilities other than those having to do with health and sanitation. It will provide them with all the advantages possessed by municipal ownership and none of the disadvantages such as political management, inability or unwillingness to make extensions, etc., etc.

[1]President Southern California Edison Company, Los Angeles.

FIELD MEASUREMENTS OF PUMP DISCHARGE.

[The Energy Club is an informal organization of San Francisco power and machinery men which meets at lunch at the Palace Hotel on Wednesday noon. Pumping for irrigation has been the main topic for discussion in the past. On October 2 Professor W. T. Durand of Stanford University spoke on the Diesel Engine and on October 9 Prof. E. B. Etcheverry of the University of California will speak on Irrigation. The following paper is the recommendations for field measurements of pump discharge by a committee consisting of A. C. Paulsmeier, H. P. Pitts and Fred Hanson. —Editor.]

We are agreed that the ordinary test that can be made in the field under almost all conditions is that of measuring the quantity of water by means of a weir box and obtaining the suction and discharge head by means of gauges; the horsepower input to motor to be ascertained by watt meter or other electrical instruments as commonly used for that purpose.

We recommend the weir box method because it can be built of material that is available almost anywhere. Furthermore, a weir box can be installed permanently, and gives the rancher or other water user a constant check on the amount of water that his pump is delivering. This amount may vary considerably during a season, owing to the fluctuating water plane. Many ranchers, particularly in Southern California, are now, and have been, installing discharge boxes made of concrete, arranged with a weir in one corner, consisting of a piece of plate steel embedded in the concrete, giving them a fair measurement of the amount of water delivered by the pump. The only criticism that might be made in this connection is the tendency to make the discharge boxes so small that the water approaches the weir with considerable velocity, meaning inaccurate measurement and indicating a greater discharge than that for which the pump is given credit.

We are aware that for large pump units a weir box is not to be recommended, because of the expense entailed in the building of them, and other means, such as pitot tubes, should be resorted to. This is particularly important in pumps used for reclamation service, where it would be rather difficult to measure the water, as it is generally discharged into the river, and any measurements that were taken would have to be made on the suction side.

Your committee believes, however, that pitot tube measurements should only be taken by an expert, as the accuracy of measurement by this means depends upon careful calibration of the instrument.

Your committee calls attention to several points in connection with the suction and discharge piping on pumps and the position of gauges when inserted in these pipes, for the purpose of ascertaining suction and discharge head. It is one of the rules to place these gauges always in that portion of the pipe which is subject to the lowest possible velocity, and in this connection, we should like to impress most forcibly upon anyone who has any connection with the operation of pumps, that the water entering the suction of a centrifugal pump should have its velocity increased gradually, and it can only be properly done by means of a taper. A taper discharge piece is also of importance. The gauges should be tapped into the large end of these tapers, or immediately outside of these in the piping, as there the velocity is comparatively low and a true reading may be ascertained. It is better to neglect the friction head occasioned by passing the water through the tapers than place the gauges near the pump where the velocity is probably quite high, and where a true reading cannot be obtained.

We believe that it is agreed by all that a pressure gauge indicates the pressure in pounds to the center of the dial, and that a vacuum gauge indicates the vacuum in the suction at the point where it is tapped into the pipe or other part of the suction connection; also, that the vertical distance between the point of tapping into the suction pipe and the center of the dial of the pressure gauge must be added to the head indicated by the two gauges.

This is the usually accepted method for obtaining the total dynamic head against which a pump operates, but it may be of interest to state that the vacuum gauge indicates the velocity head in the suction; in other words, the head, namely $\frac{v^2}{2g}$ represents the energy required to bring the water from a state of rest into that of the particular velocity that prevails at the point where the gauge is connected. Such velocity head, should, theoretically speaking, be deducted from the suction head; on the other hand, the pressure gauge on the discharge pipe does not indicate the velocity head of the discharge water, and for all ordinary purposes one may neglect these values as they will practically offset each other.

As to the size of weir boxes, your committee is not at this time ready to make any specific recommendation, as it would be necessary to make up some sort of table to cover boxes of different capacities. The main point to be considered in any weir box is to construct it in such a manner that the velocity of approach is practically nil.

Quoting from Professor G. E. P. Smith in Bulletin No. 57 from the Agricultural Experiment Station of the University of Arizona:

"Of the various methods of measuring water, the miner's inch box has long since fallen into disrepute, and for good reasons. The use of current meters is too expensive for general use, and rating flumes are open to the same objection, as the rating itself is difficult and expensive. But in weirs we have a method which is both cheap and simple."

The concrete dimensions of box and notch for measuring various flows may be determined from the following table:

Flow in Miner's Inches. 40 inches = 1 sec. ft.	Width of notch.	Depth of notch.	Length of box.	Width of box.
Between 15 and 50	1 ft.	7 in.	8 ft.	3 ft.
" 30 " 180	2 ft.	10 in.	10 ft.	5 ft.
" 40 " 360	3 ft.	12 in.	16 ft.	7 ft.
" 60 " 550	4 ft.	13 in.	16 ft.	8 ft.
" 80 " 750	5 ft.	14 in.	18 ft.	10 ft.
" 100 " 1000	6 ft.	15 in.	18 ft.	11 ft.

USE OF ELECTRIC POWER FOR IRRIGATION AND OTHER RURAL PURPOSES.[1]

BY GEORGE C. ARROWSMITH.

In the Pacific Northwest, which includes Central Washington, where this treatise is written, irrigation is king, because there are so many thousands of acres of land that are absolutely unproductive without it, and therefore worthless; but with irrigation these lands, according to location, become amongst the most productive in the world today and have productive values of from $50 to $500 per acre year, according to kind of crop grown and degree of cultivation, such crops as alfalfa giving fair return the first year, and fruit from four to six years.

Up to date, comparatively only a small area of these arid regions is being irrigated, either by gravity canals or power pumps, or yet being served by public utility or public service corporations, and do not think either of these corporations have as yet quite grasped the tremendous possibilities for development—along legitimate lines—that await the advent of their various lines. These arid regions, when put into cultivation by means of irrigation, being so productive and so valuable have, from time to time, attracted the attention of undesirables who, heretofore, have been able to borrow large sums from banks, etc., on what appeared to be legitimate and feasible irrigation schemes by either gravity or pumping, but which were floated only for personal and immediate gain on the promoter's part, and again there has been money advanced on schemes floated that were perfectly feasible but which failed because of mismanagement. Either or both of these cases mentioned has had the effect of causing the banks and money centers to refuse loans on any and all irrigation schemes, regardless of merit; whereas, if every irrigation project that has been started had been started and carried on along legitimate lines, irrigation securities would hold first place in the banks' lists today, and power companies should use every endeavor—in and out of their sphere—to see that no fake scheme is floated, and bring about a feeling of confidence with banks and money centers, so as to bring irrigation securities to where they rightfully belong, and that is first place.

Commercially speaking, the valley of the Rhine, in Germany, is five hundred years old, has had the advantage of transportation and public utilities for generations, and is supposed to be one of the best cultivated and most productive regions of the world today, our arid regions, speaking in the same sense, have had but a few years of scattered endeavor, and I venture to say, that with another twenty years of concerted endeavor their productive value for the same area will have far outstripped that of the Rhine valley.

Then again, comparing the Eastern States with the Pacific Northwest, the former have had the advantage of public service and public utilities many years ahead of the latter; yet the latter is overtaking its older rival by leaps and bounds, until finally we shall not have to look to the East for money or any other commodity, but stand on our own bottom, absolutely sound; and the chief agent to accomplish this is the ever faithful, constant servant and empire builder, electricity. Yet not electricity alone will accomplish all this, as it will require the power companies to do the pioneering to establish absolute confidence between themselves and the farmer; establish confidence in the money centers, and induce public service corporations to follow in thir footsteps, the whole forming a combination that will create untold wealth in the Pacific Northwest.

[1]Paper presented at Portland convention N. W. Electric Light & Power Association, Sept. 11-13, 1912.

The Farmer.

Having met him in all his moods and phases; seen his struggles against all kinds of odds; seen his sterling qualities, he is, in my estimation, the best and most solid of our citizens today; is worthy of any trust reposed in him, and believe that he will meet any obligation he undertakes; provided, however, he gets just what it has been agreed that he was to have; and, granted that this be done, there will be less "kicking" from him than from any other source, he becoming rated A-1 on the books of the power company. And it should be the duty of the power companies not only to see that its own treatment of him is absolutely right, but to see to it, as far as possible, that he gets a square deal from all others in this connection.

Some say he is skeptical and always looking for the best end, and this may be because, perhaps, he has been—by accident or design—treated in a manner as to make him so. But as a class he is the broadest minded of men, and, as must necessarily be in the irrigated regions, possessed of considerable means to develop his property; and every effort should be made to meet him half way or more, and as before stated, he will not be found wanting.

The Land Speculator.

In proportion as the real farmer is good for the development of the country, so is the land speculator a detriment to the country, as he never expects to develop the land himself, but holds the same at high value and expects to get a still higher value without any of his own effort and solely through the hard work of the real farmer, by reason of the general rise in value of the district in which such land is cultivated; and anything that a power company can do to discourage speculation of this kind should be done, even to advocating a higher tax on unimproved property.

Promoter of Bona Fide Large Irrigation Projects.

Where it is feasible to obtain water for pumping in individual units the system should be encouraged as against all others, but there are numerous causes that, due to the general situation, water supply and topography, where the individual system is not practicable, in which case promoters of bona fide projects would be encouraged by the power companies and aided as far as possible to finance the project, but at the same time endeavor to get them to plan, operate and sell their land on such a system as to make it feasible and possible for the purchaser to make good, and think that a power company operating in an arid region could not do better than to carefully investigate the subject and install one fairly large system on the best plans that make the development possible, and thus set a standard of values that will force others to follow, by its example showing what can be done, and at the same time making it impossible for others to float wildcat projects.

Electric Pumping.

As I said before, electricity is the chief agent for the building up of the Pacific Northwest, and chief amongst its uses is that of being used as power for pumping water for irrigating arid or semi-arid lands, as this is the root from which all other branches of the power company's business springs, because, as the gravity canals have heretofore developed large areas of land from which sprung cities with their commercial loads of all kinds, so as these districts are further developed by electric pumping these commercial loads will increase, and as new districts are brought under cultivation by electric pumping, new towns and centers with their commercial loads spring up, and as electric pumping is all done during the summer months when commercial load is comparatively light, and as electric pumping has a diversity factor of its own, I predict that any power company fortunate enough to be situated in districts of this kind can and will build up a total station annual load factor of 75 per cent or even better; and by judicious extensions such a power company can maintain a load factor of this kind, which matters are more fully taking up in the following chapters.

Apparatus.

There are so many different sources from which the supply of water is pumped that a great many different conditions have to be met by pump manufacturers; such conditions, for example, being,

Water lifted from deep driven wells with plunger pumps;

Boosted from artesian wells with variable lifts;

From canals and rivers with constant lifts;

From shallow dug wells with greatly varying lifts, and

From rivers with greatly varying lifts, such as the Columbia.

All of the above with constant pumping heads, and any good pump manufacturer should be able to meet these conditions.

Before the advent of power companies into the irrigation field and even now, especially through the medium of the centrifugal pump, it has been my observation that the question of efficiency, general design or workmanship has been neglected, generally speaking, by the pump manufacturers, the general result being the turning out of apparatus that was inefficient, trashy in construction, and generally unsatisfactory. This class of apparatus has been the source of great trouble to power companies in that although they did not furnish the apparatus, they get, in a secondary yet very marked degree, the grief accruing therefrom from the customer direct; and also, which is much worse, the maladvertising which comes of a dissatisfied customer.

In the supplying of apparatus and power to customers there are two different selling points; one, the pump manufacturer, who, by the way, is generally represented by an agency handling everything from a sausage machine to a flying machine, and whose sole business is the selling of machinery, and he, upon being approached by a customer for a centrifugal pump, takes out his catalog and furnishes from this stock, apparatus that he thinks will fill the bill, supplying the pump with the largest prime mover he can and keeping the promised efficiency down as low as possible, so that, generally speaking, he is sure not to have to go to the expense of changes that he would have to make if he agreed to furnish an efficiency that he knew could be made, and the apparatus fail of making. On the other hand, the power company, by its agents in the field, knows the efficiencies that the different sizes of apparatus can be made to give and gives a customer a correct estimate of his power bill and is interested in many ways in seeing that the customer gets the highest kind of efficiency, and the advent of power companies—especially those furnishing power for polyphase motors with their constant speeds—will entirely revolutionize the manufacture of pumping apparatus, in that it will force the installation of apparatus particularly adapted to the conditions specified, and of the highest grade of workmanship, design and efficiency; in fact, just as well made as the power company's machinery in its own power house.

Power companies complain, as a rule, of "trouble" they have had in connection with apparatus. Some who started to sell the customer the apparatus direct have abandoned the sale first hand, on account of too much grief. Others who have not sold apparatus have the same grief, and I claim that this has arisen solely and wholly through the furnishing of apparatus in either case that was poor of design. True, it may be that the apparatus furnished by the power companies or otherwise may have been of the best near-by obtainable; still, this does not alter the fact that better could have been furnished and should be furnished at a comparatively small increase in cost. Then again, the public complains that the power rate is too high (popular cry), but of what use or of what consistency is it to cry lower rates, when by the use of efficient apparatus the public can reduce its own rate? The reduction of power rate of, say five per cent, might be the margin between success or failure of a power company. Yet in operation today the general difference between poor and good apparatus efficiency is as high as 30 per cent.

There are several ways of obviating these troubles, one of which is for the power companies to undertake the supplying of apparatus direct and at as low a price as possible, but of course not laying themselves liable for damages, such as loss of crops, etc., due to failure of the apparatus, yet even if the power companies were liable in such cases, the installation of first class apparatus would bring such cases to a minimum, so far as legitimate losses were concerned, so that the advantages of direct sale might far overbalance the disadvantages, but of course there might develop cases of losses or damages that had no foundation in fact.

Another way would be for the power companies to investigate apparatus of the different makes very thoroughly, and having satisfied themselves as to the best and most efficient, endeavor to have installed a goodly showing of them in each district. This could be done by having the pump companies do their own demonstrating or by advising indirectly the installation of the same.

But no matter which way it be done, think that

it is up to the power companies to see—both for the protection of the customer and for their own preservation—that the apparatus is right, that it is installed right and that the customer is instructed right, whereupon "trouble" with apparatus—from which all other troubles and grievances arise—will be eliminated, or at least brought to a minimum.

Moreover, the supplying of apparatus, either by sale or supervision, need not be carried on for more than one season, as by either of these methods the standard of design and efficiency will have been set, so that after this period all apparatus of the same classes would of necessity have to be of the same general design and efficiency, and which could be maintained so long as the power companies gave the pump manufacturers to understand that a certain standard must be upheld.

Today the power companies generally keep a man in the field whose sole duty it is to attend to "trouble," and his duties practically cease at the customer's entrance switch; but in reality he is the recipient of all trouble calls from the wire to the water supply, and not generally being that kind of a man—even if it were his duty—is of little help. In cases of this kind the customer is out of water and temper and is not good to meet, especially if he is isolated and where he cannot get help, and think that power companies would do well to fix up a scheme whereby competent help could be given the customer.

As before stated, efficiency has generally been neglected, but for low heads, say up to 75 feet, there should be no difficulty in obtaining from direct connected motor to centrifugal pumps of any speed, a wire to water or over-all efficiency as follows:

Quantity in Gals. Per Min.	Head in Feet.	Combined Efficiency.
450	35 to 75	53
350	35 to 75	51
250	35 to 75	49
150	35 to 75	44
85	35 to 75	35

All other classes of apparatus, such as reciprocating pumps, having higher efficiencies than these.

Even these efficiencies are conservative and will be increased considerably by the closer attention to this class of apparatus by pump manufacturers. Combined efficiency in this case should be understood as delivering water through suitable, well planned pipe lines vertically to the total head specified.

The foregoing refers generally to apparatus of 50 horsepower or under as the irrigator who uses amounts over this, and especially the very large ones, usually purchases his apparatus under the direction of some engineer, gets better results, and of course being larger units gets, by right designs, better efficiencies.

[To be continued.]

NORTHERMOST MONUMENT SET.

The last bronze monument has been set to mark the boundary between the United States and Canada and it stands on the 141st meridian, within a few feet of the Arctic ocean, nine miles east of Demarcation point and forty miles west of Herschel island. The boundary work has been carried on by Canadian and American parties, the Canadian engineers setting the monuments as the Americans surveyed the line.

TELEPHONE INDUCTION CASES BEFORE CALIFORNIA COMMISSION.

The Railroad Commission of California has set October 16 for the hearing of the induction cases. These cases have arisen upon the complaints of the Pacific Telephone & Telegraph Company against power companies of California, in which the charge is made that the proximity of the high tension power lines to the telephone wires renders the latter non-commercial. The telephone company has stated in its complaints that the resultant induction is of such a nature as to make large sections of its line practically useless for telephone purposes. It has requested the Commission to compel the power companies to move their high tension wires from 700 feet to 2000 feet from the telephone lines.

The telephone company occupies the county roads, and the power companies, recently building in California in great numbers, have also obtained franchises for stringing their lines along these same county roads, thereby paralleling the telephone lines at distances ranging from 50 to 100 feet.

The issue assumes an additional importance by reason of the fact that the contention of the telephone company, if carried to successful conclusion, would practically insure it a monopoly in the use of the county roads in a large section of the state and would force the power companies to purchase, at heavy expense, rights of way over private holdings.

The Pacific Telephone & Telegraph Company has filed four complaints in the so-called induction cases; one directed against the Sierra & San Francisco Power Company alleging interference with the lines in Santa Clara and Monterey Counties; one against the Coast Counties Gas & Electric Company alleging interference in Santa Clara and Santa Cruz Counties; and two against the Great Western Power Company alleging interference in the section north of San Francisco Bay.

In their answers the power companies have stated that the telephone company had been given full opportunity to complain or to protest before the lines were strung; that the franchises for the use of the public roads were obtained at public hearings before the various boards of supervisors; that in many instances they have made use of what is known as the "closed delta system" to prevent induction; and finally that in practical operation the power lines have not interfered with the telephone wires in a degree to impair the service.

The power companies have uniformly pointed out in their answers filed with the Commission that if the contention of the Pacific Telephone & Telegraph Company were upheld as sound, it would work an insurmountable hardship upon the power corporations, for the reason that the state is interlaced with the wires of telephone companies great and small, and the sections in which power companies could run their lines and maintain a distance of 1000 to 2000 feet would be so limited as to curtail the distributing market for electric power below the point of fair returns.

The Railroad Commission has inaugurated an investigation into the whole situation, through the agency of its engineering and service departments.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Prosperity and the Election

Western securities seem to be holding their own in spite of a grilling presidential campaign now in full sway. In former years of similar political significance much uneasiness was felt on all sides, even to the material curtailing of Western construction.

Bumper crops are now being harvested, which combined with the fact that the squeezing of water from stocks in the past years has brought valuations to a stable and permanent basis, unquestionably accounts for the present firm showing. The latest government crop report is interesting and shows that the aggregate yield of grain in the United States for the season of 1912 is the largest on record.

The mills of the gods may, as of old, continue to grind slow and exceedingly small, but evidently the power man will have his hands full this fall speeding up the wheels for Uncle Sam and from all appearances the product will be anything but small.

Harmony Between Central Station and Dealers.

The proper attitude of a gas or electric company with regards to the sale of apparatus and appliances consuming its product is a much-mooted question. Should the dealer be encouraged to sell lamps and other devices at a profit or should the company do so? Or is it advisable for the company to sell at cost or less in the thought that it is in business to sell service rather than current? So intense has become this controversy that at times it has threatened to disrupt the excellent spirit of harmony which has been fostered among manufacturers, jobbers, central stations, contractors and dealers.

Historically speaking, lighting companies, whether gas or electric, sold appliances to their consumers long before dealers recognized this business opportunity. As a rule the company welcomed the advent of the dealer and did everything in its power to boost his sales. The dealer, however, has seldom reciprocated. His efforts to work up new business have too often been lax and he has been more interested in selling an old stock than in furnishing the most efficient equipment. As a result, many companies have been compelled to again take over the sale of appliances in order to increase current consumption. This has given rise to adverse criticism and even open antagonism made evident by favoring isolated plants or municipal ownership as opposed to central station service.

Like unto the ancient shield of the Druids, this question has two sides. That of the lighting company is admirably presented in the joint paper by L. H. Newbert and H. P. Pitts elsewhere in these columns Though nominally it is concerned with gas, it is equally applicable to electricity, and it is suggested that electrical readers make such mental substitution. The viewpoint of the contractor and dealer was clearly brought forth at a recent co-operative meeting at Henderson Harbor, N. Y., participated in by representatives from all the electrical interests.

The gas business, which preceded the electrical, has not reached the full measure of its possibilities because gas men have not co-operated. The companies give away stoves and the dealers try to sell coal ranges. The electrical men have recognized the eco-

nomic fact that co-oporation will enable them to market more goods with less friction at a lower ultimate cost than any other method. The market can be more quickly saturated by selling at cost plus profit than by selling at cost or less. If people have been educated to want the goods they will be willing to pay any reasonable price for them.

The central station and the manufacturer must recognize that in order for the dealer and contractor to take part in any co-operative plan appliances must be sold at a fair profit, as he is dependent solely upon the sale of the goods and not of the current. On the other hand, it is necessary for the dealer to realize that the solution of the question logically rests with him. Most companies would gladly relinquish this side line so as to devote their energies to the main issue if it were being handled in an aggressive business-like manner. It has been frequently demonstrated as an economic business proposition that the dealer is in a position to market appliances to a better advantage than the central station. The latter can well afford to carry on the introductory campaign, but leave it to the option of the consumer whether he purchase from the central station or from a legitimate dealer.

Economics of Electric Cooking

The ideal electric load for the central station is that which is uniform throughout the twenty-four hours of the day. The rapid rise of the tungsten lamp and other efficient types has had a tendency to lessen in some instances the aggregate consumption of electrical energy for illumination.

Electrical novelties and the many little niceties and conveniences in newly devised household appliances have, however, made the power consumption curve steadily rise from the horizontal in accelerated increments. Now comes the electric stove—no longer a mere curiosity with which the wealthy may play, but by its most recent strides placed within the economic reach of all.

Many have long wondered why the cheap generation of electrical energy has not previously made possible the utilization of the electric stove. Let us for a moment examine into this query.

The best average that is accomplished in the gas stove—the nearest competitor of the electric stove in our coast cities—is a consumption of say 3000 cubic feet of oil gas per month per family of five when gas is used for cooking exclusive of water heating and other utilizations. The average calorific value of oil gas manufactured in the large generators on the coast is 650 B.t.u. per cubic ft. Hence as an average a total of 1,950,000 B.t.u. are necessary to do the domestic cooking for a family of five. If an electric device be used, which does not increase the thermodynamic efficiency of the gas stove, it is plainly evident that 1,950,000 B.t.u. would there be necessary per month. One kw.-hr. of electrical energy is equivalent to 2545 B.t.u Hence, to satisfactorily perform the function above set forth a total of 257 kw.-hrs. would be necessary. At the usual price of 7c per kw.-hr., the household bill would be $18 per month as opposed to 3000 cu. ft. of gas at $1.00, or $3.00 per month. It is seen at a glance, therefore, that in order to be in the running, an electric cooking device must be a far superior article from a thermodynamic viewpoint. In a word it must consume far less energy in performing its heat inparting functions.

Considered again from the central station point of view interesting economic features are found. It is true that the usual type of electric cook stove, although demanding for its heat large quantities of electrical energy over short periods, calls, nevertheless, for this supply at times which are at present off-peak hours of the day. While this is a great stride in the right direction, ultimately, however new peaks will be thereby formed and deep valleys still remain in the daily load chart, showing many hours of the day and night in which comparatively little energy is consumed. Hence as a ultimate solution, even the electric cook stove though wonderfully improving present warped conditions, offers few happy thoughts of reflection to the power manager, endeavoring as a final solution to unify his load factor throughout the entire twenty-four hour period.

What, then, can be done?

In order to heat one pound of water one degree in temperature, it is necessary to supply one B.t.u. of heat energy. With the single exception of hydrogen gas, water will store more energy per unit of weight than any other known substance. Abundantly found in nature, its use is hence without limitation. A temperature of 240 degrees F. is amply sufficient to cook all eatables at the present time available in the household. To heat one pound of water from ordinary atmospheric temperatures of 60 degrees F. and transform the same into steam at 240 degrees F. will require some 1130 B.t.u. of heat energy. At this temperature and under a pressure of 25 lb. per sq. in.—but 10.3 lb. per sq. in. above atmospheric pressure without —a slight call upon this latent heat energy will cause some of the steam to condense into water without, however, lowering the temperature. Here then, is a means of securing a perfectly uniform temperature for cooking—the dream of the cook for ages gone by.

Recent experiments on electric cooking stoves, transferring their electric energies thus into heat energy, which in turn acting as a reservoir of abundant and uniform supply transmits its energy to eatables placed within a thoroughly heat insulated receptacle, have shown that a meal for an average family of five can be deliciously cooked with but an expenditure of from 400 to 700 watt hours. Per month this would be, for ninety meals, taking an average of 550 watt hrs. at 7c per kw.-hr., a total of $3.85. Such a load as this, however, may be ideally carried over the twenty-four hours a day and hence unquestionably central station managers will welcome its installation by the granting of a three-cent rate for electric power consumed in this manner. Indeed, many of the larger central stations on the coast have already instituted a three-cent rate for all forms of electric cooking devices.

Since one pound of water as instanced above will store 1130 B.t.u., it is seen that two pounds of water, hermetically sealed and insulated as carefully as is accomplished in the fireless cooker, will be able to store sufficient energy over the twenty-four hour run to supply the necessary heat to cook the three daily meals.

PERSONALS.

Garnett Young, manager of the Telephone-Electric Equipment Company, is taking a vacation from his San Francisco office.

F. G. Baum is expected to return to his San Francisco office on Saturday of this week from South America via New York City.

John Coffee Hays, general manager of the Mount Whitney Power Company, is on his way East, accompanied by Mrs. Hays.

S. Herbert Lanyan of Pierson-Roeding & Company, lies dangerously ill with the typhoid fever in the Good Samaritan Hospital in Portland.

B. A. Etcheverry, head of the department of irrigation at the University of California, is attending the Irrigation Congress at Salt Lake City this week.

H. H. Noble and **Rudolph W. Van Norden** have returned from an inspection of the Noble Electric Steel Company's plant at Heroult on the Pitt, Shasta County, California.

S. K. Colby, vice-president of Pierson, Roeding & Company, is at Chicago and will attend the sessions of the annual convention of the American Electric Railway Association.

Henry T. Scott, president of the Pacific Telephone Company, is at New York City, where he will transact some important business and meet Mrs. Scott on her return from Europe.

S. L. Shuffleton, who is in charge of the Stone & Webster Construction Company's work at Big Creek, near Fresno, California, for the Pacific Light & Power Company, is at Seattle.

Charles W. Baker, erecting engineer, and **K. G. Dunn**, electrical engineer with Hunt, Mirk & Co., have returned to San Francisco from Los Angeles and San Diego, where some important work is in progress.

A. S. Kalenborn recently joined the staff of the Oro Electric Corporation as an engineer on transmission work. **N. A. Eckart** is now with the engineering corps of the company, being stationed in the Humbug Valley.

F. R. Welles, a former vice-president of the Western Electric Company, in charge of the European business, who has been touring the Pacific Coast, recently visited the Yosemite Valley and San Francisco.

R. F. Oakes, president of the American Ever Ready Company's Pacific Coast department, will leave during the coming week for New York on his annual visit to the Eastern factories. He will remain about six weeks.

J. A. Fitts, engineer with L. L. Summers & Company of Chicago has returned to the home office from the Olympic Power Company's new power plant near Port Angeles, Wash., for which L. L. Summers & Company are engineers.

H. C. Coffman, president of the Chehalis & Cowlitz Railroad, has been appointed district manager of the Washington-Oregon Corporation at Chehalis, Wash., succeeding **W. B. Foshay**, who has arranged to look after other interests.

Jesse W. Churchill and **J. P. Churchill** of Yreka, who are the managing directors of the California-Oregon Power Company, are at San Francisco consulting with engineers and others concerning the extensions of their electric transmission system.

Seymour Guthrie, secretary-treasurer of the Kellogg Switchboard & Supply Company, arrived from Chicago and spent the past week at San Francisco. He was accompanied from Portland by **H. C. Goldrick**, manager of the Pacific Coast department.

R. L. Van der Naillen, general manager of the Oro Electhic Corporation, has returned to San Francisco after visiting Oroville and the scene of operations on Yellow Creek where preliminary work, including road making, is being done at the proposed power site.

S. J. Ornum, who as city engineer of Pasadena has just installed an attractive "white way" on Orange Grove avenue in that enterprising city, was an attendant at the League of California Municipalities Convention during the week, where he was elected vice-president of the engineering division.

S. V. Walton, commercial manager for the Pacific Gas & Electric Company, is making an extended trip throughout the East during which he will attend the Irrigation Congress at Salt Lake City, represent the Electrical Development League at the Boston Electric Show and inspect the workings of the large operating and manufacturing companies.

J. V. Kunze, manager of the Atlantic department of the Pelton Water Wheel Company, recently visited Los Angeles in connection with the securing of a large contract for lap-weld steel pipe for use in connection with the Los Angeles Aqueduct power transmission system. On his return trip to New York he was accompanied by Mr. Liersch, the German representative of the Ferrum Pipe Company of Germany.

A party of electric railway men left San Francisco on October 2 for Chicago to attend the annual convention of the American Electric Railway Association, October 7th to 11th, inclusive. A compartment observation car and a standard Pullman were occupied by the following from Los Angeles: J. McMillan, general manager Pacific Electric Railway Company, with his wife and daughter; S. H. Anderson, electrical engineer, and F. F. Small (and wife) mechanical engineer of the same company; S. J. Keese (and wife) Los Angeles representative of the Westinghouse Electric & Manufacturing Company; Chris. Eccles, Los Angeles manager for Eccles & Smith. From San Francisco: J. M. Yount, Master Mechanic United Railroads; J. H. Handlon, claims agent and Thomas Finnigan, purchasing agent, and W. T. Bivins, electrical engineer of same company; J. Q. Brown, assistant general manager of the San Francisco & Oakland Terminal Railways Company; F. W. Frost, secretary United Properties Company; F. A. Richards, manager car department Pierson, Roeding & Company; A. V. Thompson, railway sales agent General Electric Company; W. W. Briggs (and wife), assistant general sales-manager Westinghouse Electric & Manufacturing Company, and G. B. Kirker of the same company; H. S. Clark (and wife), Pacific Coast manager Westinghouse Air Brake Company; J. H. Steiger, Pacific Coast representative American Brake Shoe & Foundry Company, and F. H. Jones, Pacific Coast representative General Railway Signal Company.

MEETING NOTICES.

Portland Section A. I. E. E.

The next meeting of the Portland Section of the American Institute of Electrical Engineers will be held at 8 p. m., October 15, 1912, in the assembly hall of the Electric Building. A paper on "Investigation of Transmission Line Phenomena" will be presented by E. D. Searing and E. H. Le Tourneau. These will be preceded by a short talk from F. D. Weber, delegate to the Boston A. I. E. E. convention.

Portland Engineering and Architectural Societies.

At the regular weekly luncheon on September 24 of the Engineer and Architect societies of Portland, in the Elizabethan room of the Imperial Hotel, Franklin I. Fuller, vice-president of the Portland Railway, Light & Power Company, was chairman of the day. He stated that at present he was so wrapped up in the 3-cent fare ordinance that he could talk of nothing else. He then explained that from the standpoint of the company it was an ordinance that would be impossible for the company to comply with and would result

in great hardship for the patrons of the company if it was declared to be a legal act of the city council.

The second luncheon, was equally well attended and it was announced that the joint committee had decided to make the weekly luncheon a permanent feature to be held until further notice, at the Portland Hotel on Tuesday at 12:15 p. m. of each week, also it was anounced that the joint committee had decided that in the future the presidents of the different organizations should act in succession as chairman at the luncheons. The next luncheon, October 1, will be presided over by Mr. Frank Logan, president of the Portland Architectural Club.

An interesting program will be provided, the principal speaker being Marshall N. Dana of the Greater Portland Plans Association, and it is expected that a large number will be present.

It is probable that as a result of this getting together of the various engineering and architectural organizations of the city, that a combination will be affected in the near future to co-operate in the matter of securing permanent quarters for their joint use. A move has already been made in this direction and a second joint committee is in process of formation for this purpose, members having already been appointed by the A. I. E. E. and the Oregon Society of Engineers. As soon as the other organizations select members the committee will be organized and immediate action taken in the near future on this matter.

Los Angeles Section A. I. E. E.

The Los Angeles Section of the American Institute of Electrical Engineers held its opening meeting of the year 1912-1913 at Brink's Cafe on Tuesday evening, September 24, 1912. There were present 105 members and visitors. The members and visitors on arriving were given a round tag about 1½ in. in diameter, on which was written his name and the firm he was with. They attached this to the lapel of their coats, so that each man was readily identified. Music and entertainment was provided during dinner.

After dinner, Mr. Ensign, the retiring chairman, called the meeting to order and thanked the Institute and members for their support during his term in the chair and then introduced Mr. George A. Damon, the new chairman.

Mr. Damon gave a short address and said he was going to call on everybody to make a speech. He then called upon the chairman of committees, who made a few remarks, outlining the work of the coming year. The secretary was next called upon to give a brief outline of the section work during the past year. After this Mr. Damon called upon each man present to rise and tell who he was and where he was from and if he cared, to make a few remarks.

Dr. Carhart then gave an interesting lecture on his trip through Africa, illustrating same with lantern slides.

Portland Jovian Lunch Club.

A Jovian Lunch Club has been organized at Portland, weekly lunches heing held at the Hazelwood at noon on Thursday of each week. Among the speakers have been F. W. Hild, general manager, Portland Railway, Light & Power Company, F. D. Weber, of the Underwriters' Equitable Rating Bureau, C. S. Jackson of the Journal Publishing Company. The aim is to have a prominent speaker each week.

Spokane Jovian Lunch Club.

The Spokane Jovians met for a luncheon in the East room at Davenport's, September 24. After the business session was over the Statesman turned the meeting over to Mr. C. R. Bean, chairman of the day. Addresses were given by Mr. M. E. Cheney, who is the electrical inspector of the Washington State Underwriters' Association, and a splendid address was given by Mr. E. A. Lindsley on the Preservation of Timber. Thirty-six were present at the luncheon, including several visiting Jovians.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

Sept. 16.

The Southern Pacific Company applied for permission to purchase the franchises in the city of Richmond, Contra Costa County, held by John H. Nicholl, for the purpose of building an electric line from Albany to Richmond.

Sept. 17.

The Pacific Electric filed an answer denying the charge of the Long Beach Chamber of Commerce. The Long Beach Chamber of Commerce complained that the Pacific Electric failed to give adequate transfers and otherwise neglected to fulfill the terms of its franchise.

The Commission rendered a decision granting the Pacific Gas & Electric Company authority to issue $5,000,000 of bonds, the money to be used for extensive hydroelectric development on the South Yuba and Bear Rivers.

The Commission rendered a decision granting the Southern Sierras Company a certificate of public convenience and necessity to operate in Inyo County.

Sept. 18.

The Commission rendered a decision granting permission to the Home Telephone Company, of Covina, to issue 369 shares of stock.

Sept. 19.

The Coast Valleys Gas & Electric Company and the King City Water, Light & Power Company applied for authority for the latter to transfer its properties to the former.

The Southern Counties Gas Company applied for permission to issue $66,000 of bonds, for construction work and extensions.

The Central California Gas Company applied for permission to issue $30,000 of preferred stock.

The Coast Counties Gas & Electric Company filed application to purchase the property of the Davenport Light & Power Company.

Sept. 20.

The Collins Commercial Company applied for permission to run two electric wires across the streets of Newport Beach.

A brief was filed by the Tehama County Telephone Company and the Glenn County Telephone Company in their complaint against the Pacific Telephone & Telegraph Company, in which they ask for interchange of switching.

Sept. 21.

The Commission granted the Fresno Traction Company permission to construct its tracks at grade across Railroad avenue, Fresno.

The Commission rendered a decision granting the Western States Gas & Electric Company permission to issue $600,000 of bonds.

The city of Pasadena filed an argument in its action to compel the Southern California Edison Company to raise its rates.

Sept. 23.

The city of Pasadena filed a brief in its case against the Southern California Edison Company, in reply to the brief submitted by the defendant.

Sept. 24.

Decision was rendered by the Commission granting permission to the Indian Valley Electric Light & Power Company to issue 6979 chares of stock and $81, in 5 per cent bonds.

Sept. 25.

The Great Western Power Company and the North Sacramento Land & Water Company applied for an order permitting the former to purchase the electric distribution system of the latter for $9000.

The Commission rendered a decision granting authority to the Tulare County Power Company to mortgage all its property to Thomas C. Job to secure an indebtedness in the amount of $175,000.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

WIRING REQUIREMENTS AT PORTLAND.

The light and power department of the Portland Railway, Light & Power Company has issued a booklet of rules and regulations governing the installation of wiring for light and power to be connected to their system. These requirements cover provisions which are not included in the Rules and Regulations of the Board of Fire Underwriters, and are deemed necessary as a protection to the customer and to the company. The company reserves the right to refuse to connect, or the right to disconnect, any installation which does not conform to them.

(A) General Wiring.

(a) Architects and contractors are requested to consult the company in regard to the location of the service outlets and meters.

(b) The company will be glad at any time to assist, free of charge, architects, contractors or owners with advice from its engineers, relative to drawing up plans and specifications for electric wiring.

(c) Wiring contractors are requested to leave their card in the cabinet box or fastened to the meter loop, for the benefit of the company in case of a misunderstanding or trouble relative to the wiring, and also where it is possible, leave a card fastened to the meter loop having thereon the name of the customer on the premises.

(d) All wiring must be done in accordance with the Rules and Regulations of the National Electrical Code, in addition to conforming to the herein requirements.

(e) All installations of more than twelve (12) sockets or requiring more than 660 watts must be wired 3-wire, with load balanced as far as possible, except as noted in the next paragraph, and in Section "B," paragraphs (c) and (d).

(f) Residences, apartments or flats having an installation of 24 sockets or less, or requiring 1320 watts or less, must be wired for 2-wire service.

By a socket is meant any kind of a lamp receptacle.

(g) Where the cooking, heating and small power equipment in residences, flats, apartments, etc., exceeds 2 kw. of connected load, the service for same will be supplied through a separate meter at a flat rate of 4 c per kw.-hr. for all consumption, providing the consumer signs a separate contract covering this additional service.

Minimum charge—$1.00 per month.

(h) Meters should always be located as near as possible to the point where the service enters the building, or as near as possible to, and on customer's side of the main line switch and cut-out.

(i) No person other than a duly authorized agent of the company is permitted to tamper or in any way interfere with the company's property, such as meters, service boxes, switches, etc.

(j) The company must always be notified before additions or alterations are to be made to the installation.

(k) The company provides transformer service cable, and meter capacity sufficient for the original installation, and any additional load may damage any or all. According to the terms of the contract with the company, the customer would be held liable for such damage.

(l) If alterations in wiring require shifting of the meter, the company must be notified in advance, as under no circumstances is any one other than a duly authorized agent of the company allowed to handle or interfere with the meter or its connections.

(B) Sign Wiring.

(a) The wires for all circuits to signs must be installed in conduit, and no outlet box of any description will be permitted in sign conduit runs. In long conduit runs, a condulet with a blank metal cover is recommended.

(b) In wiring for signs, separate meter loops must be provided for the installation of separate meters for the signs, and the controlling switch must be installed at such a point as to be accessible to the company's employes at all hours of the day and night.

(c) All signs wired for 110-120 volt lamps having more than 33 receptacles or requiring more than 660 watts, must be wired for a 3-wire service with load balanced.

(d) All signs wired for 110-120 volt lamps having 33 receptacles or less, or requiring 660 watts or less, may be wired for a 2-wire service.

(e) All signs that are to be equipped with 12-volt, 5-watt Mazda sign lamps, must be wired on the multiple-series system in the underground district, and on the regular multiple system in the overhead district. The multiple-series signs must have ten (10) multiples in series, and each multiple of any one series must contain the same number of lamps, and that number must not be less than ten (10) lamps.

(f) The wiring for all multiple-series signs must be arranged for connection to a 2-wire, 120 volt feeder-circuit when the number of lamps in the sign is between one hundred (100) and two hundred (200), and for connection to a 3-wire 120-240 volt feeder-circuit when the number of lamps is two hundred (200) or over.

(Signs of less than one hundred (100) lamps must not be wired on the multiple-series system.)

(g) The regular multiple signs in the overhead district that are to be equipped with 12 volt Mazda sign lamps, must be supplied with and connected to a 120 volt to 12 volt transformer, when the load is 660 watts or less, and to a 240 volt to 12 volt transformer when the load is more than 660 watts.

(C) Service Connections.

(a) None of the work necessary to connect an installation will be done by the company, until a contract for service has been signed by the firm or individual who is to pay for the current.

(b) Service will not be connected until the installation has been inspected and approved by the company's inspector.

(c) The company will not connect its service until all wiring is completed and all fixtures, cut-outs and switches are installed, except as provided in paragraph (d) below.

(d) If temporary connection to an installation is desired, apply in writing to the commercial department of the company, where special arrangements may be made.

(e) No charge will be made for the ordinary connection unless it be temporary.

(D) Lamps.

(a) The Edison Base Lamp is the standard of the company.

(b) The consumer must furnish the first installation of incandescent lamps, except as provided in paragraph (e).

(c) All carbon and Gem filament lamps (not including tungsten and tantalum lamps) of the sizes specified below, which have been purchased from this company and which have been burned out or blackened in use, will be replaced by the company free of charge upon the return of the old lamps, provided the burned out or blackened lamps were used on the regular lighting meter rate service.

(d) Free lamp renewals are furnished in the following sizes only: 4 c.p., 8 c.p., 16 c.p., 32 c.p. and 50 c.p., clear or frosted.

(e) High efficiency Gem lamps of sizes known as Nos. 3, 4 and 5, with prismatic glass reflectors, will be furnished and installed free of charge (they to remain the property

or the company). The necessary wiring and receptacles for same must be provided by the customer.

(f) When burned out or blackened in use, Nos. 3, 4 and 5 Gem lamps of the make supplied by the company will be replaced free of charge upon the return of the old lamps, provided the lamps were used on the regular lighting meter rate service.

(To be continued.)

PORTLAND ELECTRICAL CONTRACTORS' ASSOCIATION NOTES.

The Portland Electrical Contractors' Association, organized less than one year ago by the principal local electrical contractors, is very active in matters pertaining to their branch of the electrical industry and much harmonious enthusiasm prevails. Regular meetings of the association are held on the second and fourth Tuesdays of each month and the executive committee meets every Thursday. Association meetings are held at 6:30 p. m. when the members have their evening dinner together at one of the principal hotels after which the business of the association is transacted. To insure a good attendance at meetings, each member is assessed the amount of the meal whether he is present or not and it goes without saying that no meals are missed unless unavoidably so. Aside from the penalty feature—which is more important—is the intense interest shown in the many subjects presented for consideration.

As a result largely of the association's efforts the city of Portland recently enacted and put into force a satisfactory inspection ordinance and the members are much pleased with the manner in which Mr. Dunlap, chief inspector, is working in harmony with the contractors. At a recent meeting of the association there were present as the association's guests, Mr. Dunlap and his deputies and Mr. F. D. Weber of the Underwriters' Equitable Rating Bureau. Many questions germane to inspection matters regarding which there had been a difference of opinion, were discussed and conclusions reached. This plan eliminates the confusion and misunderstandings between the inspection department and the contractors for all concerned receives a bulletin covering each ruling so that all are informed as to what is required.

One of the principal subjects for future attention is a state license law for electrical contractors. Data is being assembled on this subject and probably active measures will soon be taken to have the bill enacted.

The West Coast Engineering Company of Portland are rewiring the Morquam Building. The installation being in rigid conduit, except the wiring of individual rooms which will be installed in flexible conduit. This contract is of more than ordinary interest as the building is of the old type of fireproof construction of concrete and tile and a steel frame. The rigid conduit in the halls and vertical risers have all been concealed. The flexible will be entirely concealed in the rooms. A new service and marble switchboard are to be installed.

The Dings Electric Company of Centralia has been awarded the contract for wiring the city of Tono preparatory to starting up the new power plant under construction. The contract includes the wiring of 100 houses, stores, opera house and street lights.

SAN FRANCISCO ELECTRICAL CONTRACTORS' NOTES.

The National Electric Company were awarded the wiring for the St. Francis Church at the corner of Vallejo street and Columbus avenue.

The Central Electric Company were awarded the contract for wiring an apartment house for W. Wilson on Mason street and Latham place, San Francisco, for the sum of $4450.

N. Hope of the Turney Electric Company and W. S. Hanbridge left Saturday night for the Santa Cruz Mountains on a business trip.

A wiring contract is soon to be let on the new Wigwam Theater on Mission street. The steel frame was recently let. The wiring will probably amount to about $4000. Charles L. Phillips is the illuminating engineer.

TRADE NOTES.

An exhibit of Klein electricians' and linemen's tools will be shown in connection with the Western Electric Company's exhibit Space No. 414, at the American Electric Railway Manufacturers' Association Convention, International Amphitheatre, Union Stock Yards, Chicago, Ill., October 7th to October 12th.

The General Electric Company announces that the order recently secured from the United Railroads of San Francisco calls for 65 G. E., four 40 h.p. motor car equipments with K. 28 J. controllers. The contract for the car bodies was placed with the American Car Company, represented by Pierson, Roeding & Co., and the trucks will be furnished by the J. G. Brill Company, represented by the same agents. The brakes will be supplied by the National Brake and Electric Company, Eccles & Smith agents. The seating capacity of each car is fifty passengers.

BOOK REVIEWS.

Wireless Telegraphy and Wireless Telephony. By Chas. G. Ashley and Chas. B. Haywood, size 6½ in. x 9 in.; 141 pages; replete with illustrations. Published by the American School of Correspondence and for sale by the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price $1.00.

The uses of wireless telegraphy and telephony are many and important. To mention its life saving power alone is to secure for it a high claim to consideration. The authors of this book, both electrical engineers by profession have set forth in an interesting and attractive manner the history and principles of this great modern method of transmitting intelligence through space without the use of wires. The book is thoroughly illustrated. It contains no higher mathematics and yet sets forth the principles involved in a lucid and comprehensive manner. It will prove of interest and value to the layman desirous of gaining an insight into this great system of intelligence transmission, but especially will it prove of interest to that great body of men training themselves to be operators in this new field of endeavor.

Small Water Supplies. By F. Noel Taylor, C. E. Size 5½x7½ in.; 174 pages; 126 illustrations from drawings and photographs cloth binding. Published by D. Van Nostrand Co. and for sale at the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price $2.00.

The author of this book, who is a member of the Institute of Municipal Engineers and the compiler of "A Manual of Civil Engineering Practice" has treated this subject in an easy, direct style. Too frequently the young engineer in the pursuit of his technical training has so much emphasis laid upon the great engineering feats of the profession, that the small things of life are completely overlooked Especially is this true in the building of small dams and weirs, the installation of moderate sized pipe lines and the operation of small pumps. Here is a book treating of these small, often totally neglected, subjects. In the West thousands of these small structures are daily being installed in the high mountains or arid valleys. The book before us does not delve too deeply into mathematics to befog man of but moderate attainments in the rudiments of engineering. The following subjects are treated: Properties of water and sources of supply; wells and well sinking; flow of water in channels and pipes; pumping waters, and storage and distribution. It should find a welcome place among the younger members of the profession and indeed with all those interested in installations of this nature on a small scale of construction.

INDUSTRIAL

GENERAL OFFICE BUILDING OF FORT WAYNE ELECTRIC WORKS.

The general office building of the Fort Wayne Electric Works of the General Electric Company is located on the same grounds as the factory buildings, and overlooks one of Fort Wayne's beautiful public parks. This modern office building, erected during the summer of 1911, is a five-story structure having a ground plan of 60 feet by 140 feet. The walls are built of structural steel and brick, and the floors are reinforced concrete slabs supported by steel latticed girders of the general steel structure. In short, the construction is throughout of the most approved and up-to-date form.

The various floors of the building are served by two Otis high speed electrically driven elevators, each one having a capacity of fifteen passengers or a freight capacity of 2500 pounds. The various floors may also be reached by two square stairways, one located at each end of the building. An extension steel fire escape is also provided for emergency service in case of fire, although the building throughout is as near fireproof as it is possible to construct.

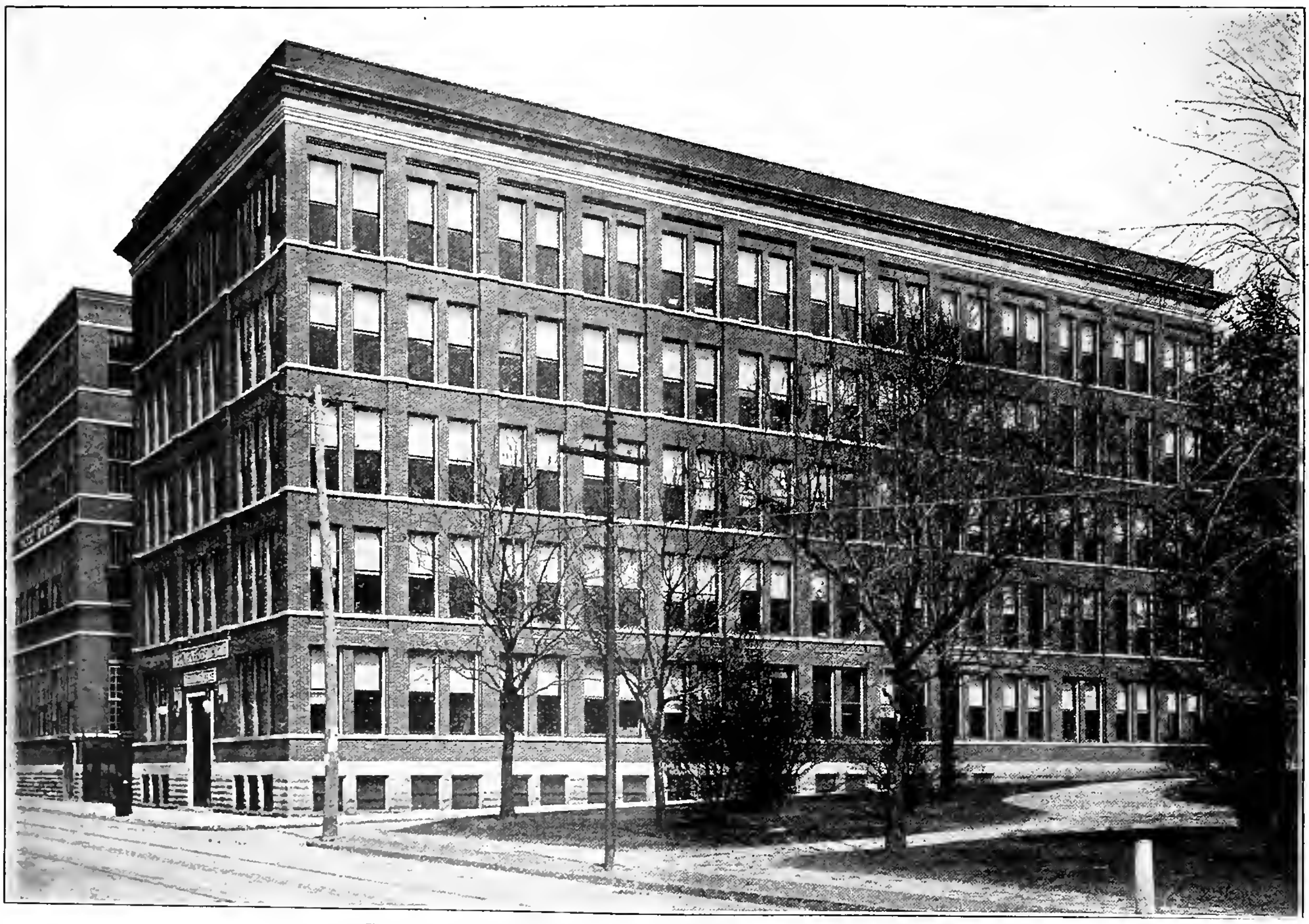
The building is equipped throughout with Grinell automatic sprinklers and a double equipment of fire hose on each floor. Fire proof vaults are also provided on each of the floors.

The rooms which serve as separate offices for the various departments are arranged on either side of the longitudinal halls. The wood work throughout is quarter sawed golden oak, finished in keeping with the other high class construction.

The building is so located and the offices so arranged that during the bright hours of the day there is an abundance of natural light. The required artificial light is furnished by a direct system of incandescent lighting, using 100 watt Mazda lamps with Holophane reflectors. The system is so efficient and the distribution so perfect that the artificial lighting is quite as satisfactory as the natural lighting.

The building is supplied with steam heat from the central power station of the works, the radiators being arranged along the exterior walls of the building. The heat is controlled first by valves in the steam mains, located in the basement of the building, and finally by hand operated valves at the radiators.

The ventilating system used in the building is unique. The air supply is drawn from the exterior at the base of the building, by a large Sirrocco fan driven by a Fort Wayne 12 h.p. variable speed motor. The air is first passed over steam pipes and heated to a temperature somewhat near that of the rooms, and is then passed through a large Warren Webster washer where it is subject to the action of a heavy spray of water which effectually removes all dust and odors. The air is again passed over steam pipes which remove the excess moisture and at the same time heat the air to the temperature at which it is desirable to the offices. A second large motor driven fan located on the roof of the building exhausts the air from the various rooms and expels it to the outside atmosphere. The ventilating equipment has sufficient capacity to change the entire air content of the building four times every hour.



General Office Building of Fort Wayne Electric Works.

The washing of the air by the water spray naturally cools

it and in the summer season this feature is utilized to keep the temperature of the rooms below that of the outside atmosphere, in fact the system is so effective that a temperature of seventy degrees can be maintained in the offices during the hottest days in summer.

An unique use is made of the telephone transmitter in connection with the motors used on the ventilating and water systems of the building. The motors are controlled from a general switchboard remotely located and since it is desirable that the engineer in charge at the switchboard should have some way of knowing whether or not the motors are operating properly without going all over the building to the location of each one, the motors are individually supplied with a telephone transmitter with mouthpiece placed quite close to the commutator of the motor, each transmitter having its individual telephone circuit terminating in plug receptacles at the switchboard. When the engineer at the switchboard wishes to know regarding the operation of a motor, he plugs a telephone receiver into terminating receptacles in the board and is able to tell if the motors be operating properly by the pitch of the humming sound which the brushes of the motors make in passing over the commutator bars, the pitch of the sound becoming higher as the speed of the motor is increased. By this method the speed of the large motor driving the exhaust fan on the roof is controlled from the switchboard in the basement, quite as intelligently as if the motor were in plain view from the switchboard, in fact the experienced engineer can by this method control the speed of any of the motors in the building quite as accurately as if the dial of a mechanical speed indicator were registering the speed directly before his eyes.

The office building contains the two panel private telephone switchboard which at present serves some 78 phones in the office and some 63 phones in the factory, and has exchange accommodations for a total of 180 'phones; moreover, each floor has its own private annunciator service, and a call bell system controlled from the private telephone exchange serves to locate the chief officials wherever they may be, in office or factory.

The electric wiring of this office is especially complete. There are a number of extra telephone and annunciator circuits, terminating in plug receptacles located at regular intervals around the base boards of the various rooms, so that no matter where it may be desirable to place a desk, there will be a convenient terminal for the plugging in of telephone and annunciator. There are also power circuits provided with numerous plug receptacle outlets at the base boards so that desk lamps and small power motors, etc., can be accommodated should they at any time be desired.

The building is also piped for vacuum cleaning service although this feature is not utilized at the present time.

No expense has been spared in equipping this office building in the most approved and up-to-date manner. The increased efficiency of the office force has shown that the added expense was more than justified.

ADJUSTABLE SPEED PAPER MACHINE DRIVE.

Speed range, speed regulation and sufficient power at each speed are of prime consideration in paper-machine drives and for all machines requiring any appreciable speed range the use of direct-current motors becomes necessary and a direct-current supply is therefore required.

When the main energy supply is alternating current, as is usually the case in paper mills, direct current is most advantageously obtained by means of a synchronous motor-generator since it runs at high speed, which is constant regardless of load, occupies little space, requires practically no attention, and improves the power factor of the system.

With direct-current motors three methods of speed control are possible.

1. Entirely by motor field control.
2. Entirely by armature voltage control.
3. Partly by motor field and partly by armature voltage control.

Although the first method may appear the cheapest in a plant where there are several machines, because it seems to require only one constant voltage, the method is open to at least three objections: First starting and stopping individual motors, disturbs the voltage enough to affect other machines, making a separate generator preferable for each machine, even with field control; second, with constant voltage and field control, the capacity of a motor remains constant at all speeds, while the power required to drive a paper machine varies with the speed; in this case the motor must be too large for slow speeds in order to have enough capacity for the high speeds; third, only a limited range can be satisfactorily obtained.

With armature voltage control, the second method, a motor can develop practically full-load at all speeds, but the full speed range by voltage control is not advisable for three reasons: First, the torque required by a paper machine is somewhat greater at low than at high speeds, so that a motor designed for the maximum speed conditions is not capable of carrying the load at low speeds; second, the regulation of a generator and motor at low voltages is not good, hence only a limited range can be obtained by this method; third, the ventilation of the motor is much poorer at low speeds and the temperature will increase as full-load torque or over is developed.

By using part motor field and part armature voltage control the exact power requirements can be met with the least investment and also the best speed regulation.

The experience of the Westinghouse Electric & Manufacturing Company favors the last method.

Systems have been installed with a speed range of 10 to 1, although this is necessary only in mills producing a large variety of products. The first cost of the electrical equipment for such a system, is slightly greater than for smaller speed ranges. Actual service has demonstrated that this system is reliable and easily controlled, that it gives very close regulation and maximum production.

NEW CATALOGUES.

Bulletin No. 501 from the Triumph Electric Company is devoted to the Triumph-Monitor Reversing Motor Planer Drive, a direct connected motor and controller involving several newly patented features and which it is claimed greatly increases the output from the planer.

Descriptive Leaflet 2480 issued by the Westinghouse Electric & Manufacturing Company covers rules for the selection of machine tool motors and gives some valuable information relative to this subject, together with several application views. Descriptive Leaflet 3516 also covers machine tool motor applications giving ratings and class of motors which are suitable for the various types of machine tools. This is exceedingly interesting information put up in serviceable form. A diagram is also given which shows the relation between the cutting speed in feet per minute and the area of cut in square inches, also the cubic inches of cut per minute.

The General Electric Company has designed and standardized switchboard panels which long experience and accurate knowledge of requirements have demonstrated will successfully meet the demands for which they are intended, and has just issued two bulletins; one illustrating and describing alternating current switchboard panels for three-phase, three-wire circuits, of 240, 480 and 600 volts, 25 to 60 cycles, and the other describing direct current switchboards, double polarity, 125, 250 and 600 volts. These bulletins are numbered 4996 and 4995, respectively.

NEWS NOTES

INCORPORATIONS.

OROVILLE, CAL.—Deer Creek Power Company $1,000,000 shares, $100 each, subscribed $5000, by M. C. Polk, C. L. Crowder, L. M. Fletcher, F. H. Polk and P. Henshaw.

ILLUMINATION.

TACOMA, WASH.—The City Commission has awarded the contract for copper wire to be used in the municipal lighting system to Bowie & Love, of Tacoma. Price, $7560.

SAN BERNARDINO, CAL.—The Southern Sierras Power Company of this city is preparing to invade the Yucaipa valley, Redlands, Banning, Beaumont and the intermediate section.

KELSO, WASH.—The Independent Electric Company has been granted the right to construct electric light lines and transmission lines over and along the roads and streets in Cowlitz county.

CHINO, CAL.—Sealed bids will be received up to November 25th for a franchise granting the right to maintain for 25 years a system of gas pipe lines along the streets of the city of Chino.

ALAMEDA, CAL.—The Electricity Commission has accepted the plans of M. C. Couchot for a new building to house the municipal light plant. The building is to be of steel and concrete and will cover a large amount of new machinery.

VANCOUVER, B. C.—Bids will be received by Wm. McQueen, city clerk, up to October 17th for the installation of ornamental light standards on Main, Granville, Harris and Hastings streets. Marked check for 5 per cent of the bid required, payable to the city treasurer.

LAS VEGAS, N. M.—The city council has empowered the water and light committee to contract with the Las Vegas Light & Power Company for a suitable system of street illumination, provided the annual expense does not exceed $2000 and the contract does not have a life of over five years.

PORT ALBERNI, B. C.—Anderson, Warden & Wilkin, consulting engineers, Williams building, have been commissioned to prepare plans and estimates for a proposed electric light plant at this place. It is possible that the Canadian Pacific Lumber Company will be asked to supply the power and that lights will be afforded early in 1913.

EDMONTON, CANADA.—The city of Edmonton, Alberta, which is figuring on expending $1,000,000 on a gas distributing plant and other buildings this year, has taken out permits for car barns costing $50,000; power house extension, $40,000, and civic shops, $19,000, upon which work is in progress. The gas plant will cost $771,000.

TULARE, CAL.—Authority to the Tulare County Power Company to execute a mortgage of all its property to Thos. C. Job to secure an indebtedness of $175,000 has been granted by the Railroad Commission. The company at the present time is indebted to Job only in the sum of $50,000 and the decision requires that the mortgage be placed in escrow and be delivered to Job when he shall place the sum of $125,000 in the hands of the trustee. The money is desired to liquidate existing indebtedness incurred largely in the purchase of machinery.

PORTLAND, ORE.—The Northwestern Electric Company, of which Herbert Fleishhackeer of San Francisco is president, has been granted a 25-year franchise to distribute electric power in Portland to be transmitted at 66,000 volts from hydroelectric plants on the White Salmon River. For this franchise the Northwestern Electric Company agrees to pay a yearly rental of 3 per cent of all power sold, put up a $100,000 bond to be forfeited to the city if $300,000 worth of work is not done on the company property within two years, permit the use of its poles for the city's fire alarm system and give the city power to condemn all its physical property if it should sell out to a competing concern. A maximum of 9 cents per kilowatt hour is established for lights, with from 5 cents to 1 cent the rate for power, according to the quantity. Referendum petitions are being circulated to have this matter placed before the voters at an election next June.

TRANSMISSION.

GRASS VALLEY, CAL.—Managing Director John Andrews is to have electricity installed at the Quicksilver mine near Alleghany.

JACKSONVILLE, ORE.—It is announced that the California-Oregon Power Company will at once construct lines, including a line to Jacksonville.

HILGER, MONT.—The Kendall Light & Power Company, has secured a franchise to install electric lights here and will run a line from its power plant on Warm Springs Creek.

MANHATTAN, NEV.—A high current power line is being erected between the substation of the Nevada-California Power Company and the Manhattan Water Company's well on the Tonopah road. An electric pump will be running as soon as the line is ready.

NAMPA, IDAHO.—The Swan Falls power plant, now the property of the Mainland interests and which furnishes power for all the towns in this vicinity, is to be doubled in capacity before the end of next year. A transmission line is to be constructed connecting the Swan Falls plant with the irrigation district south of Mountainhome.

AMERICAN FALLS, IDAHO.—James H. Brady has transferred his electric power interests in Idaho to Kuhn Brothers of Pennsylvania. Over $2,000,000 was paid over to the ex-governor for his holdings. The deal involves the power site at American Falls, together with the power house now built and in operation and the new power house now under construction at the place named. The transmission lines and substations located at Pocatello, Blackfoot and other southeastern points, together with the lighting contracts in Pocatello, Blackfoot and elsewhere were also included.

CONCRETE, WASH.—E. C. Macey, superintendent of construction of the Bellingham district of Stone & Webster Engineering Corporation, is looking over the route for bringing in their new power transmission line. Stone & Webster will, within a few weeks, begin the construction of two transformer stations, one at each of the cement plants here. C. H. Tornquist, an engineer of the Bellingham district, will look after the work.

SAN FRANCISCO, CAL.—In granting the Indian Valley Electric Co. permission to issue 6979 shares of stock and 5 per cent bonds to $81,535 the Railroad Commission settled an interesting point of policy that had been worrying several power companies. At the hearing on the application for the issue representatives of the Round Valley Water Company appeared, and stated that they were about to construct a plant in territory that the Indian Valley Company intends to serve. They said they did not oppose the application of the other company, but merely notified the commission of their intention, so that it might be taken into consideration when the Indian Valley Company's request was passed upon. In commenting upon this the commission says in its decision: In reaching its decision on the present application, the Commission will not refuse authority to one utility to issue securities on the ground that another utility may thereafter enter the field and compete with the existing utility in such a manner as to injure its business and impair the value of its securities. The commission will judge each application on

its merits, but will not be foreclosed by the grant to one utility of the right to issue securities, from thereafter permitting another utility of like character to enter the same field in case the public convenience and necessity demand such action. As has been frequently said by this commission, the commission does not guarantee any stocks, bonds or other securities which it authorizes, and no order of authorization can thereafter be used to prevent this commission from taking such action as it may consider necessary in behalf of the public convenience and necessity as affecting either the utility which secures the authorization or any other utility. The commission, consequently, will judge of the present application on its own merits, irrespective of possible subsequent competition.

TELEPHONE AND TELEGRAPH.

EL PASO, TEX.—The North Western line is repairing the telegraph lines and equipment, and the bridges destroyed by the rebels are being permanently reconstructed.

CANUTILLO, MEX.—The Tri-State Telephone Company has started work on its new line from El Paso to Denver, Mr. Riely is in charge of the construction camp at Canutillo.

BREMERTON, WASH.—A board of naval officers is engaged in making a survey of the higher ground near the entrance to Puget Sound for a new wireless station, the Tatoosh station having proved inefficient.

PORTLAND, ORE.—The electrical workers of Portland have declared a strike against the Postal Telegraph Company because of their refusal to pay the minimum wage scale of journeymen electrical workers.

LAKEPORT, CAL.—Application has been made by the Lake County Telephone Association for a franchise to construct a telephone system in the town of Lakeport. Sealed bids will be received up to November 4th for the sale of said franchise.

TOMBSTONE, ARIZ.—R. J. Selkirk, supervisor of the Coronado national forest, is considering the feasibility of constructing a telephone line from Canille to Ft. Huachuca, and from that point to connect with Huschuca ranger station. The total distance is estimated at 25 miles.

LOS ANGELES, CAL.—The Marconi Wireless Telegraph Company of America is making many changes in equipment in stations formerly operated by the United, and will modernize all stations and boats. The station located at East San Pedro will be thoroughly overhauled and modernized.

TRANSPORTATION.

STOCKTON, CAL.—The Stockton Electric Railway Co. has made application for a franchise granting the privilege to construct and operate a double or single track street railroad through the streets of Stockton. Bids will be received up to October 14th for the sale of said franchise.

PORTLAND, ORE.—One-fourth of the work on the Southern Pacific's interurban electrification from Portland to Eugene, has been completed. Track-laying, rail-bonding, pole-setting and wire stringing is well under way along the 100-mile loop and many of the city lines are being reconstructed.

PORTLAND, ORE.—The city council has passed an ordinance which makes it illegal for the Portland, Railway, Light & Power Company to collect more than 3 cents from passengers after the seats are filled. A temporary injunction has been brought by the company and the case is being heard before the United States District Court.

SEATTLE, WASH.—Local railway men are inclined to believe that J. P. Graves of the Spokane & Inland is behind negotiations for the purchase of the Highland Park & Lake Burien electric road, now nine miles long, from Seattle to Lake Burien. It is thought to be the first link in an interurban chain to Tacoma, Olympia, Chehalis and Portland.

EUGENE, ORE.—W. E. Coman, general freight and passenger agent of the Hill lines in Oregon, has advised the president of the Eugene Commercial Club of the definite announcement by Joseph H. Young, president of the same railroad system, that the Albany-Eugene extension of the Oregon Electric Railway would be completed and in operation in time to permit of a celebration of the event by the people of Lane County October 15.

SAN JOSE, CAL.—The adjourned hearing of the application if the San Jose Terminal Railway Company for leave to issue $650,000 bonds to cover the cost of extensive construction work was called before Commissioner Thelen Thursday afternoon. H. H. McCloskey, the counsel for the terminal company, supported its contention and was opposed by Col. D. H. Bryant of San Jose, who appeared in behalf of Mrs. Mary E. Lockwood of New York and other protestants. Colonel Bryant's view was that the Railroad Commission should not authorize the issuance of any bonds until the terminal company had first paid his client $14,000, alleged to be due on a contract of sale of some of the property. J. J. Mahoney, the president of the terminal company; Vice-President and General Manager John A. Mehling; Secretary M. J. Gardner and Chief Engineer W. E. Gruver attended the hearing.

SAN FRANCISCO, CAL.—An agreement is near between the city and the United Railroads for the joint use of the outer tracks on lower Market street. The United Railroads is willing to assign to the city its Sutter street franchise controlling the tracks on condition that it be given the right to operate its Sutter street cars to the ferry. It is ready to give the Geary street municipal railway cars the primary right to run over the outer tracks down Market street, to share its wires, tracks and poles with the city and to grant every other important concession which the city asks. But the company will not forfeit its alleged right to operate the Sutter street cars over the contested route. Briefly, it is ready to concede anything and everything as long as it retains the right to send the Sutter street cars to the waterfront. It is not particular under what agreement it shall do this, as long as it is legal and absolutely secure. W. M. Abbott, counsel for the United Railroads, offered the above terms and similar propositions to the Supervisors' public utilities committee at a conference Monday.

LOS ANGELES, CAL.—The principal points in the notice of sale of the San Pedro street franchise are as follows: Maximum limit of franchise 21 years and city reserves the right to purchase on one-year notice. If the city exercises its option within five years after the date of the franchise it will pay exact cost; after five years 75 per cent. City is to supervise construction and determine cost of labor and materials. The Pacific Electric and Los Angeles Railway have the right to joint use of the line with the city for seven years from date of franchise even if the city should purchase. The city reserves the right to grant any other company a franchise to use the line jointly for the seven-year tenure. If the city purchases before the expiration of seven years the railroads having joint use are to pay rental equal to 5 per cent of the price paid by the city. This rental is apportioned on a car mileage basis and the cost of maintenance is apportioned in the same way. The board of public utilities is given the right to determine the number of cars that may be operated over the line. Only three cars to a train are permitted except by special permission of the board of public utilities. Only passengers and U. S. mail may be carried by the railroad. The municipal line may carry freight. Grooved girder rails are required and the railroads must pave between the tracks. The track must be maintained to 85 per cent of the first cost during the seven years tenure. The line must be completed within five months from date of franchise. September 4, 1912—Council rejects notice of sale and decides to hold street open for municipal road. September 10, 1912—Council reconsiders its action in rejecting notice of sale. September 17, 1912—Council orders notice of sale published, bids for the franchise to be received October 8th.

ALPHABETICAL INDEX TO ADVERTISERS

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity, Power and Gas, Rialto Building, San Francisco.

OFFICE AND STORAGE ROOM FOR RENT.—Very desirable location for Electrical Manufacturers' Agents. Levy Electric Co., 539 Market St., opp. Sansome, San Francisco, Cal.

FOR SALE.—Surveying instruments of Keuffel & Esser design, including transit, level, protractors, level rods, tapes, aneroid barometer; all practically new; will sell at once for 65 per cent of catalog value. Box 35, Journal of Electricity, Power and Gas.

WANTED.—A first-class man to fill position as head of the Stores and Supplies Department of a large Electric Company operating in California; must be capable, efficient, energetic and well informed as to store keeping and store accounting on an extensive scale. Reply, stating experience and references, Box 66, Journal of Electricity, Power and Gas.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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Where to Buy It in the West, Pages 9, 10. Alphabetical Index to Advertisers, Page 8

JOURNAL OF ELECTRICITY

POWER AND GAS

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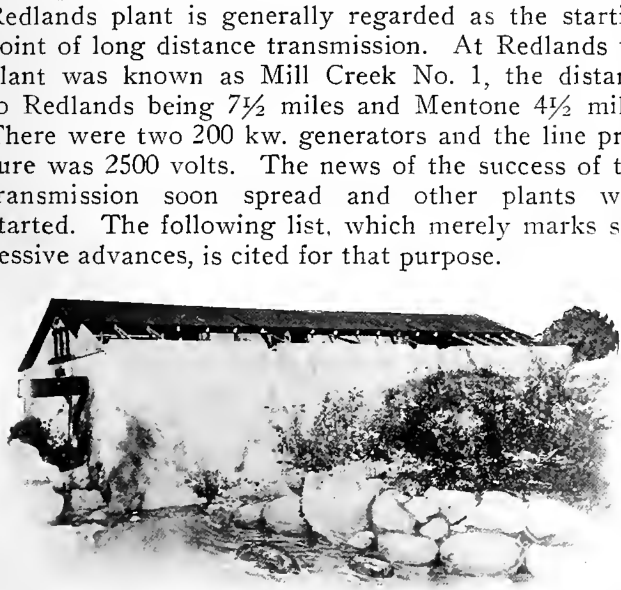
VOLUME XXIX | SAN FRANCISCO, OCTOBER 12, 1912 | NUMBER 15

HYDRO-ELECTRIC POWER PLANTS IN CALIFORNIA[1]

BY J. D. GALLOWAY.

It is now about twenty years ago since the first three-phase plant was commenced near Redlands. It was placed in operation September 7, 1893. The single-phase plant at Oregon City transmitting power to Portland had been operating since 1888 but as three-phase transmission has become standard, the Redlands plant is generally regarded as the starting point of long distance transmission. At Redlands the plant was known as Mill Creek No. 1, the distance to Redlands being 7½ miles and Mentone 4½ miles. There were two 200 kw. generators and the line pressure was 2500 volts. The news of the success of this transmission soon spread and other plants were started. The following list, which merely marks successive advances, is cited for that purpose.



The San Antonia or Original Sierra Plant as it Looks Today.

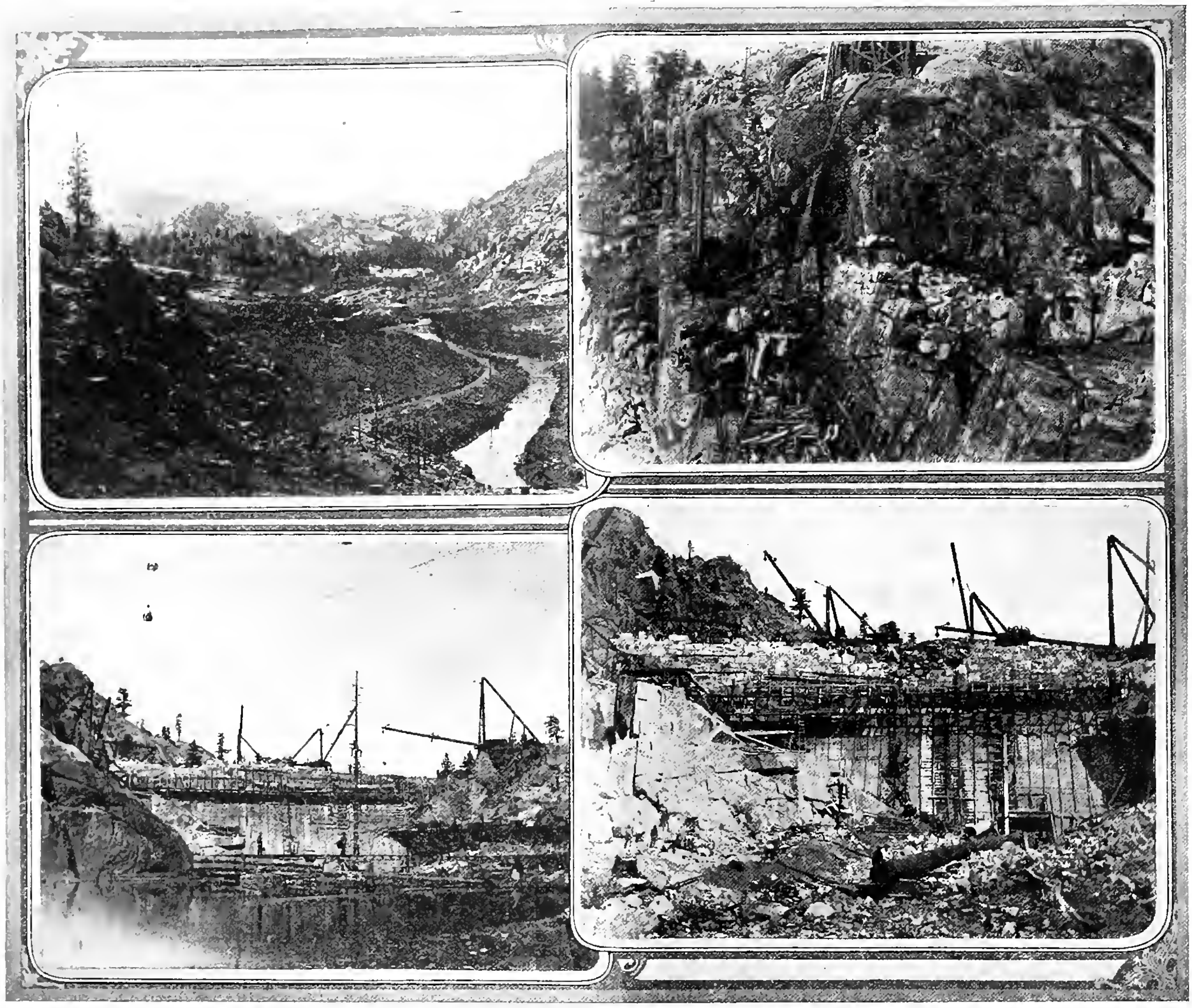
In July, 1895, the Folsom plant, transmitting power at 11,000 volts to Sacramento, 22½ miles, was placed in operation. In December of the same year, the small plant of the Nevada County Electric Power Company of 1000 horsepower was started. It transmitted power at 5500 volts to Nevada City, 8 miles. It is notable as the beginning of the Pacific Gas & Electric Company. In April, 1896, the San Joaquin Electric Company started delivering power to Fresno, 34½ miles, at 11,000 volts. Impulse wheels were used here under 1411 ft. head. showing a rapid development from the water wheel standpoint. In 1898 the Pioneer Electric Company at Ogden, Utah, commenced operation, transmitting power 36 miles at 11,000 volts. The first plant at Niagara was started that year, transmitting power to Buffalo, 26 miles, at 11,000 volts. In February, 1898, the Telluride Power Company, at Provo, Utah, transmitted power 35 miles at 40,000 volts.

Early in 1899 the Southern California Power Company placed in operation a line 86 miles long at 33,000 volts pressure. In June, 1901, the Bay Counties Power Company first operated the line from Colgate to Oakland, 141 miles, at 40,000 volts. The Great Western Power Company commenced operating at 100,000 volts in 1908 and the Sierra & San Francisco Power Company at a similar voltage in 1910. The limit of increase in voltage and distance is not yet reached.

The size of generators used shows a similar evolution. At Redlands the generators were of 200 kw. capacity. At Folsom, 1905, 750 kw.; at Ogden, 1896, 750 kw.; at Snoqualmie Falls, 1899, 1500 kw.; at Colgate, 1901, 2000 kw.; at de Sabla, 1904, 5000 kw.; and at Las Plumas, 1908, 10,000 kw. P. T. Hanscom proposed a 25,000 kw. unit at Las Plumas this year and the generator and turbine builders gave bids to build it, but the timid easterners were afraid and so someone else must take that step.

My connection with the hydroelectric development commenced that day in May, 1900, when Eugene de Sabla asked if it were possible to suspend a steel cable across the Straits of Carquinez. Designs for the crossing had been prepared by Mr. Koetitz, of the Pacific Construction Company, and the crossing was built. I may not have been as certain of success then as I am now, but the crossing was successful from the start. The really doubtful point was to insulate the cables and this was accomplished by Mr. Sterling. At the towers, the cables rest upon a wooden saddle which in turn rests upon six pin insulators. The first ones installed have been replaced but they stood up under 40,000 volts. The strain insulators, which are placed where the cable is fastened to the anchorages, gave the most trouble. Porcelain was tried but broke under the pressure and then Mr. Stirling devised a combination mica and oil insulator which proved successful. I may be pardoned for referring to this old work, but it has stood the test

[1]Read before the San Francisco Section of the A. I. E. E., Sept. 27, 1912.



Reservoir Site and Dam at Relief Valley During Construction.

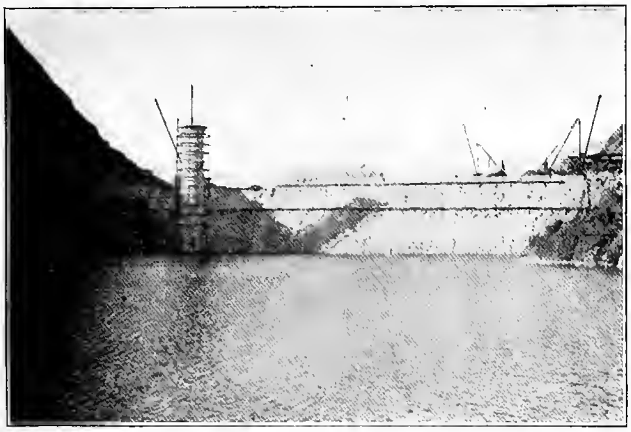
of time and we thought we were doing big things in those days. For length of span this has never been exceeded. There was some question as to whether the wires would swing together in a wind, but this has never occurred to my knowledge.

One feature of mountain plants is the storage reservoir. The necessity for this was recognized at an early date but as it is a costly item it has not always been installed. Probably the most comprehensive system of storage reservoirs was built on the Standard Electric Company's system at Electra. To the miners of early days, we owe the creation of the rock fill dam. Wm. R. Eckart, beside rebuilding the old Blue Lakes dam, constructed the dams at Meadow Lake and Bear Valley. They are of the rock fill type and each about 75 ft. high. The front and rear faces are of derrick laid rock on about ¾ to one slope. They were faced with three layers of plank calked. The leakage a number of years ago, was about three hundred miners' inches, which was negligible. I made plans for two dams of this type on Bishop Creek for the Nevada-California Power Company, but did not superintend the construction. The power company omitted the derrick laid rock on the first dam, merely throwing in loose rock. Considerable settlement took place and the inner skin of planking was distorted, allowing a large leakage. In the dam at Relief Valley on the Sierra and San Francisco Power Company now about 140 ft. high, the laid rock wall is over 100 ft. thick at the bottom, backed with a loose rock fill. This dam is faced with a reinforced concrete skin three feet thick at the top. I joined with Professor C. D. Marx in advising a layer of steel plates in the concrete, but Messrs. Meredith and Frye thought the concrete would do. In this they were in accordance with Sanderson & Porter, the constructing engineers, and time has proved the reinforced concrete a good material. A good example of rock fill dams is the Morena dam recently completed by M. M. O'Shaugnessy near San Diego.

At the present time there are two large dams being constructed, that of the Great Western Power Company at Big Meadows and that of the Pacific Gas & Electric Company at Lake Spaulding. The former is to be of concrete arches of short span resting on buttresses placed in series across the river. This dam will create one of the largest reservoirs in the world, the ultimate storage being over fifty billion cubic feet of water. The Lake Spaulding dam will be of rubble masonry, over three hundred feet high and will impound, if I am correctly informed, some four billion cubic feet of water.

Diverting Dams.

The other dams with which the engineer has to deal in this work is the diverting dam at the head of the flume. That at Electra is a low concrete structure. At Colgate the original dam of the Browns Valley Irrigation District was a log crib filled with rock. When the power company took over that property and built the new flume this dam was raised. In a flood it went out on February 22, 1904. Some quick work was necessary to get a new masonry dam in that summer. It is about 45 ft. high and some 200 ft. long. F. G. Baum hit upon the idea of pumping water from the river into the flume. The pumps, of which there were five, the largest 24 in., lifted the water some 15 ft. and at the power house it dropped seven hundred, thus giving about one-third the normal plant capacity through the summer. One of those pleasant experiences came when we were building that dam. In no previous September in the records had it ever rained a total of one inch, but about the middle of the month came a rain of seven inches and that gentle stream raised 14 ft. in twenty-four hours. Flumes, trestles, derricks went down stream. One boiler was found at Smartsville, some twenty miles below. We finished the dam, however, early in November.



Morena Rock-Fill Dam.

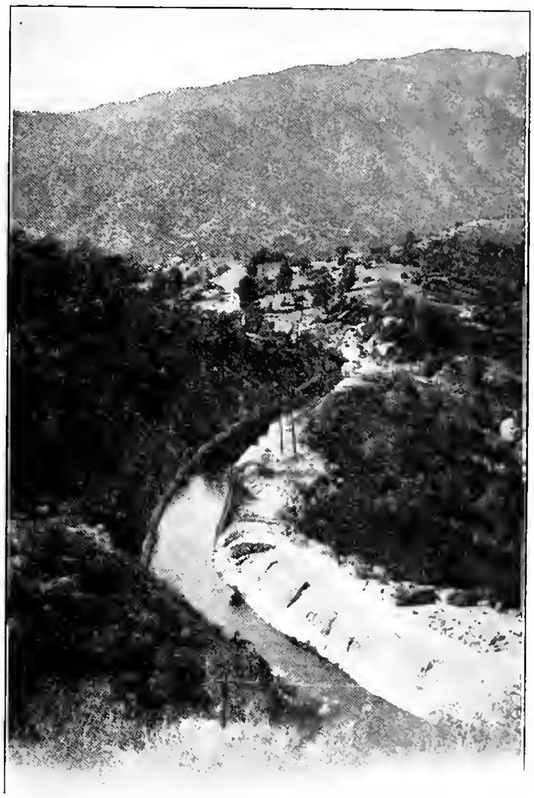
The dam of the Great Western Power Company at Big Bend is also a concrete masonry structure, 330 ft. long on the crest and about 60 ft. high. During this last summer, in order to obtain greater pondage ten foot flashboards were placed on top of this dam. These were made of timber frames placed every eight feet across the dam and covered with vertical wooden needles. In the recent rise of the river these flashboards had 2½ ft. of water over the top without injury.

The dam of the Sierra and San Francisco Power Company at Sand Bar Flat on the Stanislaus is a timber crib, filled with rock and faced front and back with boards. It is about thirty feet high. The water enters a masonry chamber through openings protected by screens and gates placed nearly parallel with the stream. At de Sabla the dam on Butte Creek is a small timber crib.

Flumes and Ditches.

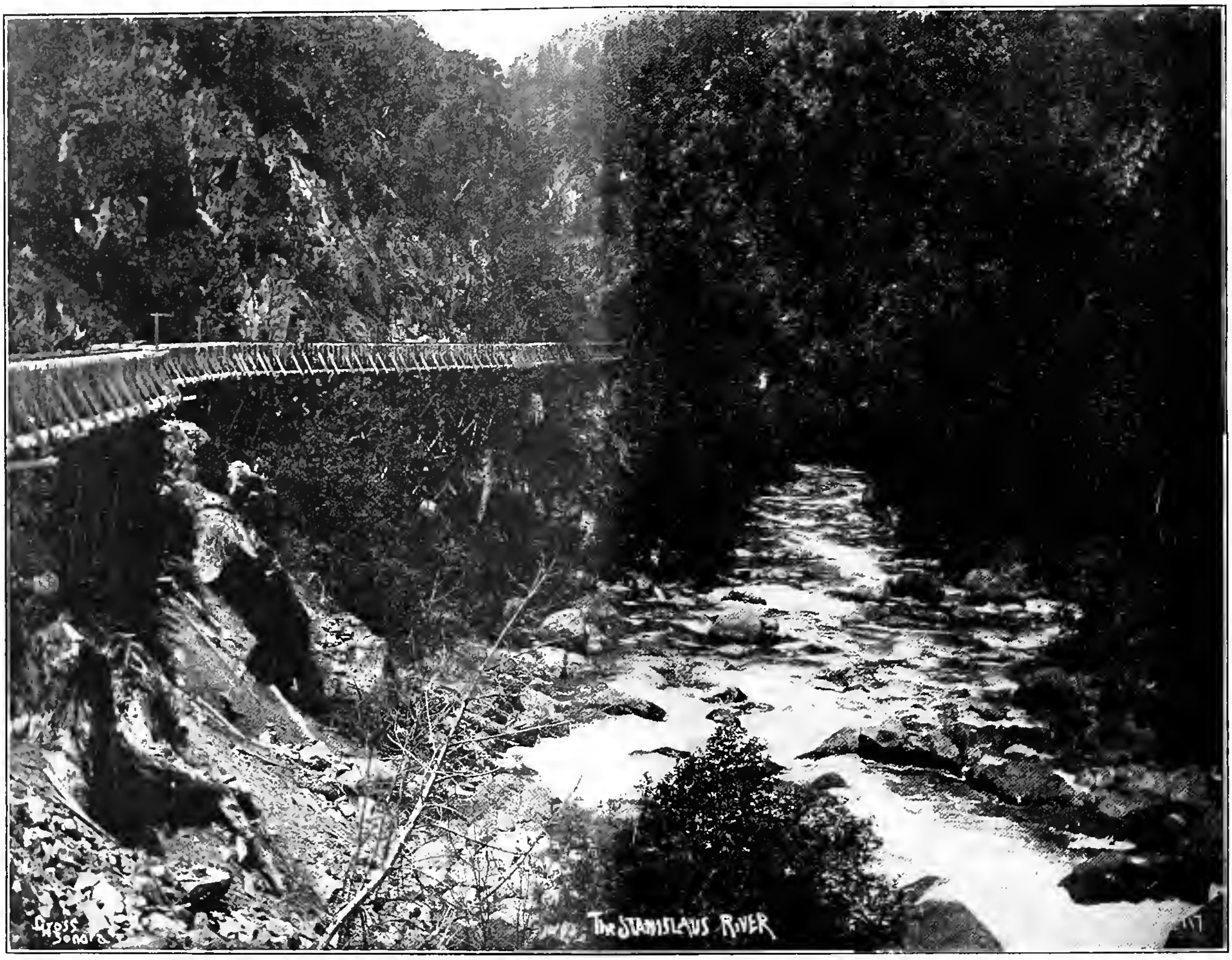
In many of the existing plants the location of the entire plant was determined by some old ditch built by miners. Such for instance is that of the Tuolumne Water, Light & Power Company, the Standard Electric Company, where the Amador ditch was used; the Utica plant; the Great Western Power Company, where an abandoned mining tunnel was used; the Oro Water, Light & Power Company, where the old Miocene ditch was adapted and de Sabla, where the Cherokee ditch was taken. At Colgate an Irrigation District flume was the determining feature which located the plant. Kern River No. 1 and Stanislaus were the only large plants not so influenced.

The ditches encounter a number of different soils. The red volcanic earth found in a large number of cases becomes practically water tight. Much leakage occurs in lava rock and in the shale such as occurs at Electra. In the southern part of the state where water is less abundant, ditches have been lined with concrete. A good example is the second plant of the Mt. Whitney Company on the Kaweah. Grades ordinarily average from 6 ft. to 8 ft. per mile but in red earth greater slopes can be used. One short part of the de Sabla Toadtown ditch has over 20 ft. to the mile slope without erosion.



Borel Canal, Concrete Lined.

The wooden flume reached a finished development in California before the power plant era. Some notable flumes are those at Colgate, 6 ft. high and 7 ft. wide and 8 miles long; at Stanislaus 9 ft. wide, 6 ft. high and about 14.8 miles long and at Fleisch on the Truckee River, 10 ft. wide, 6 ft. high and 8900 ft. long. The longitudinal boards are usually 1½ in. thick and as wide as the timber can be sawed. They are usually surfaced on one side. The longitudinal cracks are closed by ⅝ in. x 4 in. battens or as at Fleisch, the planks are grooved and a tongue inserted. The planks are bound by the belting courses placed



Wooden Flume in Stanislaus Canyon.

every four feet. These in turn, rest upon stringers supported on framed bents placed every 16 ft. Grades of 10 ft. to the mile are common, such being used at Colgate and Stanislaus. The velocity of water is very swift at this grade, about 10 ft. per second and if the bottom is out of grade standing waves will originate. A well graded flume should have no trouble from this cause. I have seen water go down a timber flume 300 ft. to a mile grade with little disturbance.

The flume is a temporary expedient and as timber grows more costly, will disappear. It must be admitted that many bold pieces of construction have ben carried out in this work and that the wooden flume has served an important purpose in the development of power plants.

Regulating Reservoirs.

At the end of conduit there should be a regulating reservoir but in many cases there is not. In the earlier plants the importance of the load factor was not recognized. At Electra the upper ditch has only a small reservoir—not nearly large enough and surplus water is spilled down to Tabeaud 200 ft. below At Colgate there is no reservoir. An idea was advanced to install pumps which at low load would be operated to pump surplus water up to Lake Frances, some 400 ft. up hill. No power was obtained by the water returning through this height as it ran in an open pipe. This scheme was not practicable and was not used. At de Sabla, Lime Saddle, and Stanislaus there are reservoirs of ample size to take the daily load variations and also provide a small reserve in case of accident to the conduit. At Big Bend the flash boards mentioned above were built to serve more pondage. At Bishop Creek the first dam at plant No. 4 has been replaced by one giving greater pondage and a fair sized reservoir at Plant No. 2 gives regulation. In some cases, where a number of plants are operated in parallel, the governing and the load changes are taken care of at that particular plant, which has a regulating reservoir.

Pipes.

Riveted steel pipes were highly developed in California by the gold miners. The Cherokee siphon built about 1869 has a head of about 910 ft. The pipe of the Virginia City water works has a head of 1720 ft. across the Washoe Valley with a length of over seven miles. It is 12 in. inside diameter and was built in 1872-3 by Hermann Schussler.

There was thus precedent for the high heads when the power plants were commenced. The following table gives a list of some power plants with data as to conduits, head, and other matters:

Plant.	Length of Conduit.		Head in Ft.	Ratio.
de Sabla	12.5 miles	66,000 ft.	1,530	2.32%
Colgate	8 miles	42,300 ft.	698	1.65%
Electra	19.5 miles	103,000 ft.	1,466	1.42%
Big Bend	2.9 miles	15,168 ft.	450	2.97%
Stanislaus	15.2 miles	80,100 ft.	1,500	1.87%
Centerville ...	8 miles	12,000 ft.	577	1.38%
Bishop No. 4..	2.3 miles	12,200 ft.	1,100	9.05%

At de Sabla, the upper part of the two pipes is riveted plates and the power part 30 in. outside diameter lap welded and flanged. At Colgate the upper part of the pipes is riveted and the lower part cast iron. At Big Bend the first four pipes, 5 ft. diameter, are lap welded. There are now being installed two additional pipes 6 ft. diameter of riveted plates. At Electra the upper section is wood stave where the pressure is light. In the first two pipes next follows some cast iron sections and then lap welded pipe. The third pipe is of riveted plates. At Stanislaus the upper sections are six foot wood stave and lower sections 48 in. and 38 in. riveted pipe. At Bishop Plant No. 4 there are 2.3 miles of wood stave pipe. The first pipe is 30 in. lap welded pipe and the second pipe riveted plates. At Kern River No. 1 the penstock was a pressure tunnel with a lining of thin steel plate. In some way a leak occurred in the lining and water entered the strata of the hill under pressure. Then when the pipe was emptied, the outside pressure collapsed the lining and it was necessary to install, at considerable loss of efficiency, time and money, a pressure pipe inside of the tunnel.

Here I will advance a statement that will certainly cause discussion. I am a firm believer in the superiority of well designed riveted pipe. I have never known one to fail. In the case of lap welded pipe I do not know from personal experience of one, either foreign or of domestic make which has not been patched and banded, or which has burst, with disastrous effects, under high heads. Testimony from other engineers is to the same effect, although there are numbers of lap welded pipes in the world giving satisfaction. I am aware of the difference in friction losses and also of the lesser cost. At Stanislaus five years ago the lap welded pipe was 10 per cent cheaper but was not used. However, if one could see how welded pipe can break with the resulting destruction at the power house there would be little left of an argument.

One thing, sometimes forgotten, is the use of air valves or stand pipes. Calculations of pipe stiffness may also show them able to withstand air pressure when the water column is broken but there are a number of reasons why the pipe will not hold. At Bishop we were laying a 48 in. wood stave pipe near the hydraulic grade line. It was practically level. To keep portions of the pipe wet after completion, dams were built in the pipe about every 500 ft. and the pipe filled with water. One night the lowest dam broke and the water ran out. The air pressure crushed down the pipe at the upper end of that section so that it was necessary to rebuild about 100 ft. A number of accidents have happened allowing water to escape from pipes at the lower end and nearly always the pipe at the upper end has collapsed so that opposite sides have come together.

Air valves should be large size, say 6 in. or 8 in. placed on high points or not over 1000 ft. apart, and provided with a gate valve below. At intervals, the gate valve should be closed and the air valve moved from its seat. This will prevent its "freezing" in place. I know of one place where the pipe collapsed and the air valves were found frozen to their seats. At Bishop the bonnet of a gate valve broke under 1100 ft. pressure, the pipe emptied but the air valves worked and the pipe was uninjured.

In designing pipes, I use for the metal, Manufacturers' Standard Specifications Medium Steel of from 60,000 lb. to 65,000 lb. ultimate strength. The allowed stress is taken at 16,000 lb. per sq. in. afterwards reduced by the joint efficiency to about 11,000 lb. to 12,500 per sq. in. Ordinary double riveted joints can be made of 70 per cent efficiency in thin plates and with triple riveted butt strap joints, an efficiency of 80 per cent can be obtained.

For friction losses, a value of C of 100 in the Chezy formula will give a pipe that will carry the full amount of water after years of service. The question of the economical design of pipe is one of considerable interest. Mr. Arthur Adams has deduced mathematically a rule that a particular pipe is most economical "in which the value of the energy annually lost in frictional resistance equals four-tenths (0.4) of the annual cost of the pipe line." This is a good rule but is subject to a proper understanding of the case. Within reasonable limits of pressure drop due to friction the frictional loss in pipe lines during most of the year can be neglected. There is more than enough water as a rule through nine months of the year and if a little more is passed through the pipes, it does not matter.

Again there is a question as to whether to design the pipes for the average demand for water or to make the peak load demand the criterion. If the load factor is low, say 50 per cent or 60 per cent, and if the pipe is designed for average flow, then the high velocities at peak load will result in a pressure drop. There is a point where more water through a pipe results in less power, owing to increase of friction losses. These losses increase in the ratio of some power of the velocity about the square. I know of one pipe line where this has been reached. There are so many variables in this equation that judgment must finally determine the pipe diameter after a study of the conditions.

Gate Valves.

It is necessary to have gate valves in many cases under high pressure. They should always be of cast steel. Cast iron is most unreliable and the name of the best manufacturers is no guarantee. One valve disc broke under 1500 ft. head with corresponding damage. In the metal was found a bolt head which had never melted. It is painful to recall the numerous failures of cast iron gate valves and nothing is more certain than that cast steel well annealed and of medium hardness should be used. On the new units at Big Bend we are installing six foot pivot or butterfly valves under 430 ft. head. Similar valves have been installed at White River in Washington with success. There is some leakage which is taken care of by a drain.

Water Wheels.

California has contributed to the art of hydroelectric development another important invention, the impulse or tangential water wheel. It is a product of the necessities of the gold miners. Among the names associated with the development of this form

of prime mover are those of Pelton, Knight and Doble.

The impulse wheel is a very simple machine. The form of the buckets varied in different makes. That of the Pelton is somewhat rectangular in plan. The Doble bucket is nearly an ellipsoid of revolution and would seem to be a good type as at no point is the water compelled to make a sharp turn. An important gain was made in the efficiency of the wheel when a dividing wedge was formed in the bucket, so placed that it split the jet into two equal parts, the halves being directed to opposite sides of the wheel.

The form of the jet became of importance as soon as the size of wheels began to increase over the small ones first used by the miners. The necessity of preserving the jet true to form until it reached the bucket led to the invention of the needle nozzle. A long pointed needle is introduced into the center of the jet and the curving surface of the needle directs the jet as a solid bar of water against the buckets of the wheel. The needle also acts as a valve by which the amount of water can be regulated.

The need of sudden regulation due to quick changes in load led to the invention of the deflecting nozzle. Its prototype is the hydraulic giant of the miners. A ball and socket joint allows the nozzle to be instantly deflected from the wheel when the load goes off. This deflection is taken care of by the governor. Another device arranged, I think, by Geo. J. Henry, Jr., consists of a deflector operated by the governor. This consists of a movable shield, somewhat in the shape of a bucket which is introduced into the jet and cuts off from the jet more or less water before it reaches the wheel. The nozzle is fixed and regulation is obtained by varying the position of the deflector.

The deflecting nozzle was an excellent device for medium sized wheels. It has been used on wheels up to 5000 kw. capacity as at de Sabla. It is obvious, however, that the packing of the ball and socket joint is difficult so another device, the synchronous by-pass has been brought out. Here the nozzle is fixed in position and the governor operates the needle for regulation but in order to prevent sudden rises of pressure in the pipe line due to sudden drop in load, the governor operates a by-pass valve through which the water is discharged and the flow in the pipe not materially changed. I believe Mr. Doble is installing this device on the new plant of the Los Angeles aqueduct.

The small wheels of the miners had one nozzle. Then as more power was required, two and three nozzles were placed on one wheel. This was about the limit of number of nozzles. The largest single wheel with two nozzles that I know of is at the Lime Saddle plant of the Oro Water, Light & Power Company. Here two Pelton wheels of two nozzles each operate one 1000 kw. generator. The Girard wheel, which is an impulse wheel with nozzles all around the runner has a representative at Alta. This wheel did not prove of the best efficiency under test and no more were used.

Obviously the power of a single jet is limited by the size of the jet which can not be increased indefinitely. The water must strike the bucket and curve backward and outward to its discharge. If the jet is too great in diameter there is interference of the water and decrease in efficiency. Hence the larger size single wheel can only be used where the fall is great. I believe the largest single jet in use is where the single wheel operates the 5000 kw. generator at de Sabla. Under test over 6000 kw. has been obtained from this single jet. The gross head is 1550 ft. and if I remember, the jet is about 6½ in. diameter. A similar generator was installed at Electra.

The situation at Electra gave a chance for a comparative test which was instructive. As those who are familiar with that plant know, there are two ditches 200 ft. apart vertically giving two heads, one of 1460 ft. and one of 1260 ft. In 1903, two 5000 kw. generators were installed and while one generator was equipped with one wheel on the low head, the second generator had a wheel at each end, one for each head. Tests carried out by Mr. Baum indicated a higher efficiency for the two-wheel unit when each wheel carried one-half the load than when one wheel carried the full load. It would seem that with the resulting size of jet, the most efficient size of wheel had been passed.

At Stanislaus, after considerable discussion, it was decided to install two wheels with single nozzles on the 6700 kw. generators and these generators have since been removed to give about 8500 kw. They are the largest impulse wheel driven generators although the most powerful single wheel is at de Sabla. I understand that at the Big Creek plant of the Pacific Light & Power Company, 10,000 kw. generators with two wheels are being installed. Here the head is nearly 1900 ft. and the size of the generators does not indicate a corresponding increase in size of jet over that at de Sabla where the head is 1530.

There are thus limitations which determine the amount of power to be obtained from impulse wheels. They are not adapted for relatively low heads where the generators are large. Fortunately this is just the condition where the reaction wheel or turbine is most applicable. There is a twilight zone between each type where either are available. Increased power by impulse wheels can be obtained by adding more wheels on the same shaft but this method is expensive and not subject to good regulation.

I believe the first turbine on the coast operating electric generators of large size was that at Snoqualmie Falls. It was of 10,000 h.p. capacity under some 270 ft. head. In 1906, a 1500 kw. generator was installed at Bishop Creek plant No. 5 with a turbine under 400 ft. head. The design of the turbine was poor and the runner wore out. It has since been replaced. About 1907 the 5500 kw. turbine at Centerville under 577 ft. head was installed by Mr. Baum and Mr. Wise and this is, I believe, the highest head under which a turbine is operated.

When the Big Bend plant was started in 1908, the 4-10000 kw. generators operated by single runner turbines were the largest units then built. They operate at 400 r.p.m under a gross head of 430 ft. These wheels were designed for a head of 90 ft. higher, but they have delivered 11,000 kw. under present conditions. It may be of interest to mention that bids were recently taken on units with generators of a capacity of 25,000 kw. at unity power factor and a single run-

ner turbine of 36,000 h.p. capacity. Plans of the turbine were prepared with bids and efficiency guarantees, of nearly 90 per cent given. It is not the fault of the engineers of the power company, of the turbine builders or of the generator makers that these units were not built.

The turbine is more efficient than the impulse wheel. On large units an efficiency of 87 per cent to 90 per cent can be obtained in a turbine and it uses all of the head. Efficiencies of impulse wheels of the best type range from 78 per cent to 82 per cent and some head is lost. However, each has its fairly well defined field.

Regulation of the turbine is accomplished by the variation in size of the openings through which the water enters the runner. I believe this method is familiar to all. It brings up the subject of relief valves. At Bishop we had valves operated by pressure only and they were not very successful. At Centerville a pressure operated valve was installed but it did not work satisfactorily and a device was installed to have the valve directly operated by the governor. A dash pot in the train allowed slight speed changes to be made without opening the relief valve while giving free opening in case of sudden changes.

At Big Bend the tunnel is three miles long and the energy in the moving mass of water is very great. As originally built no relief valves were installed, reliance being had to a stand pipe. This was not sufficient as heavy surges in the tunnel took three-quarters of an hour to die out, and relief valves, directly operated by the governor have been installed. Considerable credit is due Arnold Pfau for the design at Centerville and Big Bend. The new units are to have relief valves operated by oil pressure from the operating cylinders of the turbine.

Having now reached the shaft of the generator and the probable limit of your patience, the cautious civil engineer will go no farther.

ELECTRIFICATION OF MELBOURNE RAILWAYS.

For several years the officials of the Victorian State Railways have been considering the substitution of electric traction for steam locomotives on the suburban lines radiating from the city of Melbourne, Australia. The object is mainly to accelerate and improve the service on these lines, which are now becoming badly crowded. In 1911 the passenger traffic from the Flinder Street Station alone averaged 135,000 persons per day.

ELECTRIC CABLES FOR ARGENTINA.

In connection with the electrification of the suburban railway lines in and about the city of Buenos Aires a contract, which is said to be probably the largest ever placed for an electric-cable installation, and certainly the largest for extra high-tension cables, has recently been placed by the Central Argentine Railway (Ltd.) with a London telegraph works. The principal item consists of 66,000 meters (meter = 3.28 ft.) of 0.1 sq. in. paper insulated, lead covered, and armored three-phase cable for a working pressure of 20,000 volts, which is to be laid directly in the ground.

USE OF ELECTRIC POWER FOR IRRIGATION AND OTHER RURAL PURPOSES.

BY GEORGE C. ARROWSMITH.

(Continued)

Rates and Usage.

I regard a mixed rate for small units as follows:

A fixed charge of $12.00 per year per rated horsepower of customer's connected apparatus, to be paid in equal monthly installments, plus the following meter rates for energy used during each month:

First 30 kw.-hrs. per rated kw. of connected apparatus 3 cents per kw.-hr.;

Next 30 kw.hrs., per rated kw. of connected apparatus, 2 cents per kw.-hr.

Next 120 kw.-hrs., per rated kw. of connected apparatus. 1½ cents per kw.-hr.

Next 240 kw.-hrs., per rated kw. of connected apparatus, 1 cent per kw.-hr.;

All over 420 kw. hours, per rated kw. of connected apparatus, ½ cent per kw.-hr., as being fair, which rate for six months of continuous operation of full load equals a rate (including fixed charge) of $42.00 per horsepower season or year, the revenue from this, however, being increased by the amount that a customer might use for pumping water for domestic purposes or using power for general utility during the non-irrigation season. I would, however, strongly advise the fixed charge being regulated or made upon the irrigation maximum demand instead of connected load, or in other words, call the irrigation maximum demand the connected load. This I would do for three reasons:

1. The customer may want a stated supply of water at a given lift which may require power slightly in excess of a standard size motor and which then calls for the installation of the next larger size, causing the customer to pay an excess fixed charge.

2. Granted a customer—as they do—wants all the water he can get for the full load of any size motor that will supply his needs, thus working said motor at full load for 24 hours per day, 30 days in the month, and I do not consider the modern electric motor quite satisfactory to stand up under these conditions, for its otherwise natural life, especially in the hot summer months of Central Washington climate where the thermometer reaches as high as 104 degrees F. in the shade; also, as sometimes is the case, the efficiency of motors at three-fourths load is slightly greater than that at full load.

3. That in competition with gasoline power, especially to irrigate small tracts of land, the fact that the customer has to pay the excess fixed charge (as in the first clause) and especially where power is used intermittently, militates against the using of electric power.

The fact that the customer may want to use his motor for other purposes during the non-irrigation season and might then use the full power of his motor, or even overload the same, or that the lowering of the general power factor of the company's lines would result, would be offset by the diversity factor and far overshadowed by the general advantages resulting from the adoption of making the maximum demand the connected load, and which maximum demand would be obtained by operating the pumps to full capacity, which would remain the same in localities

where total heads remain the same, and in localities where loads vary, owing to the raising of suction water levels, the conditions are such that the maximum demand exists in the first part of the irrigation season; and in the case of a well designed centrifugal pump, the delivery of water should increase as the suction lift decreases, and the power decrease, but not, of course, in the same proportion nor in quite the same efficiency. For instance, take as an example a motor-driven, direct connected centrifugal pump designed to give a maximum efficiency in delivering 400 gallons per minute at a total head of 35 ft., which, due to the rise of tail water, will perform as follows:

Gal. Per Min.	Total Head.	Comb. Efficiency.	H.P. Input.
400	35	57%	6.2
425	26	51%	5.4
450	20	48%	4.5
475	12	40%	3.6

and which class of apparatus in case of rise and fall of the water supply, such as pertain on the Columbia River, enables the irrigator to supply himself with water at the right ratio during the season with a 30 per cent less horsepower demand than the irrigator with a constant total head.

The foregoing, as regards rates, has referred to the small units, and for large units I regard the same rates with a discount on the monthly metered power used as follows:

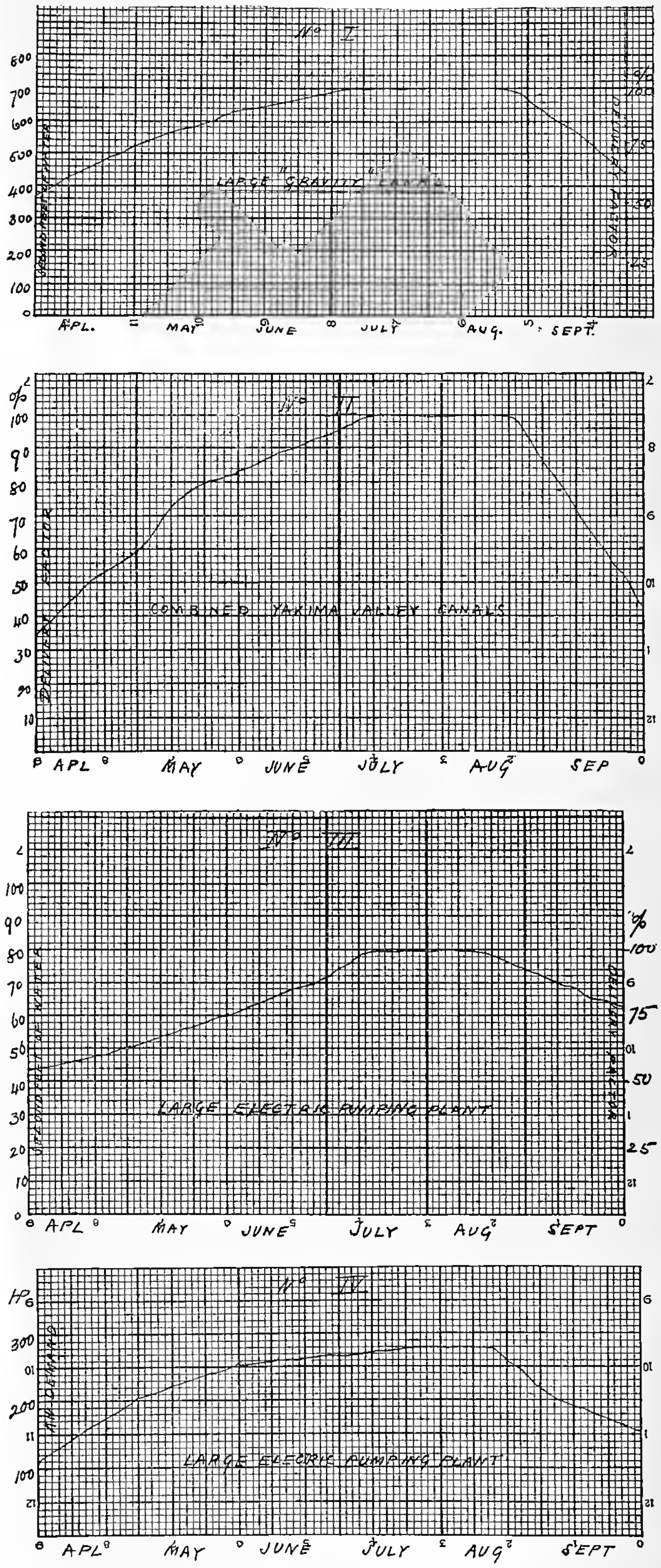
First $100.00 per month, net;
Second $100.00 per month, 15 per cent discount;
Second $200.00 per month, 25 per cent discount;
All over $400.00 per month, 35 per cent discount.

to be an equitable rate that enables large projects to be floated successfully.

I regard these rates quoted as fair to consumers and as low as is compatible with good business for power companies to make, and believe will remain so for some time to come. And as I have often quoted to customers to whom as a general rule, a reduction of 10 or 15 per cent in power rate would only make a difference of, say 50 cents per acre year, and granted that their land was in bearing, if 50 cents per acre year spelled the difference between success and failure, they had better not irrigate. And, as before in this treatise stated, of what use to cry lower rates and get a reduction of a few per cent in rate, especially when said reduction may mean teh margin of safety for a power company having a large power load of this description, when today, generally speaking, the average reduction that a customer—by reason of better apparatus and methods—can make in power used for the same or better results is about 25 or 50 per cent. And again, I claim that for their own protection, as well as for the lasting benefit of their customers, it is up to the power companies, one way or another, to see that this is done first, before any reduction in power rate be even considered.

Load Factors, Cost of Irrigation, Water Duty, Etc.

Being that irrigation by electric power is comparatively new, and methods heretofore employed have not been of the best, it is impossible to give comprehensive data on costs, etc.; but we have the exact data on water supplied by the largest gravity canal in Central Washington, and data obtained from government reports compiling all of the gravity canals in the Yakima Valleys, which delivery or consumption factor is plotted out on curves Nos. I and II, respectively, and which canals irrigate some 150,000 acres. Also we have the same factor as obtained from two of the largest hydro-electric irrigation plants in the State of Washington



Curves of Consumption Factor.

as plotted out on curves III and IV, which, as the general usage is the same, enables us to deduce the load factors for the tables of charges, costs, etc., for the 1000 horsepower and 10 horsepower installation as herein quoted in connection with the irrigation power

rates quoted in previous paragraph, and which load factor from such sources obtained will hold good for the general system. These curves and load factor tables can be added to, or plotted on, the curves of any power company's annual load so as to see what the effect of the added irrigation power load would be upon their annual load factor, and the taking on of such load be governed accordingly with surprisingly satisfactory results. However, in the case of both the curves and load factors herein plotted and mentioned no account has been taken of daily load factor, so that in plotting out these curves on to an annual load curve great care should be taken in considering the effect of the irrigation curve upon the daily load curve of the power company that abrupt peaks should not result and affect the annual curve; and no contract for irrigation power should be taken without reserving the right of compelling the customer to cut down or cut out his use of power for, say three hours per day upon request, and especially with large consumers who are easier to reach than a lot of small ones. And while this restriction upon the customer may, perhaps, seem to him bothersome and unnecessary, in practice it might be exercised only on Saturday evenings when the lighting loads are the heaviest during the week. And as is shown from the curves, the maximum demand on irrigation comes in July and August, when the lighting loads are at an annual minimum. Altogether, I regard the holding of this privilege in a contract very necessary, because in the future, as irrigation loads become heavier, it may have more of a bearing—than we think now—upon the success of the power companies, and with such cheap power they could not afford to have much of a "summer hump."

1000 Horsepower Installation.

Month.	H.P. at 100% Monthly Load Factor.	Fixed Charges.	Running Charge.	Discount.	Total Monthly Fixed Charge.	Rate Per KW.-Hr. Incl. Total Annual Charge.
April ...	520	$2,000.00	$3,908.00	$1,293.00	$4,615.00	$0.0165
May	742	2,000.00	4,675.00	1,562.00	5,113.00	.0128
June ...	825	2,000.00	4,910.00	1,644.00	5,266.00	.0118
July	1,000	2,000.00	5,352.00	1,799.00	5,553.00	.0105
August..	1,000	2,000.00	5,352.00	1,799.00	5,553.00	.0105
Sept.	520	2,000.00	3,908.00	1,293.00	4,615.00	.0165
					$30,715.00	

From the horsepower column of which is obtained the following table of monthly ratio of delivery of water, based on the total delivery of 27 acre inches per acre.

April	3.16 acre ins.,	or 11.3%	of total
May	4.5 acre ins.,	or 16.1%	of total
June	5.0 acre ins.,	or 17.8%	of total
July	6.07 acre ins.,	or 21.7%	of total
August	6.07 acre ins.,	or 21.7%	of total
September	3.2 acre ins.,	or 11.4%	of total

Also the per acre cost of delivery of water by electric power to an elevation of 100 ft, in per acre season amounts from 18 to 36 ins. with a 1000 horsepower installation working at 76 per cent season load factor, with apparatus giving a wire to water efficiency of 65 per cent:

Acre Inches.	Average Rate of Delivery.	Acres Covered.	Total Season Power Cost.	Power Cost Per Acre.
18	1 sec. ft. to 240 acres	10,600		$2.90
20	1 sec. ft. to 220 acres	9,500		3.24
24	1 sec. ft. to 180 acres	7,900	$30,715.00	3.90
27	1 sec. ft. to 160 acres	7,000		4.40
30	1 sec. ft. to 140 acres	6,200		4.95
36	1 sec. ft. to 120 acres	5,300		5.80

10 Horsepower Installation.

Month.	H.P. at 100% Monthly Load Factor.	Fixed Charge.	Meter Charge.	Total Charge.	Rate Per KW.-Hr. Incl. Total Annual Fixed Charge.
January		$10	*	$10.00	
February		10	*	10.00	
March		10	*	10.00	
April	5.2	10	$39.06	49.06	$0.0212
May	7.4	10	46.75	56.75	.0167
June	8.2	10	49.10	59.10	.0155
July	10.0	10	53.50	63.50	.0135
August	10.0	10	53.50	63.50	.0135
September ..	5.2	10	39.06	49.06	.0212
October		10	*	10.00	
November ..		10	*	10.00	
December ...		10	*	10.00	
		Total amount, 6 or 12 months..$12.00		$400.97	

*Used for purposes other than irrigation.

From the horsepower of which is obtained the following monthly ratio of delivery of water based on the total delivery of 27 acre inches per season, which percentage delivery will hold good for any water duty:

April	3.16 acre ins.,	or 11.3%	of total
May	4.5 acre ins.,	or 16.1%	of total
June	5.0 acre ins.,	or 17.8%	of total
July	6.07 acre ins.,	or 21.7%	of total
August	6.07 acre ins.,	or 21.7%	of total
September	3.2 acre ins.,	or 11.4%	of total

Also per acre cost of delivery of water by electric power to an elevation of 50 ft. in per acre season amounts from 18 to 36 ins. with a 10 horsepower installation working at 76 per cent season load factor with apparatus, giving a wire to water efficiency of 57 per cent:

Acres Ins. Per Season.	Average Rate of Delivery.	Acres Covered.	Total Season Power Cost.	Cost Per Acre Season.
18	1 sec. ft. to 240 acres	180	$400.97	$2.23
20	1 sec. ft. to 220 acres	165	400.97	2.43
24	1 sec. ft. to 180 acres	135	400.97	2.95
27	1 sec. ft. to 160 acres	122	400.97	3.29
30	1 sec. ft. to 140 acres	105	400.97	3.77
36	1 sec. ft. to 120 acres	90	400.97	4.26

However, if water could be utilized in equal amounts during the months of the season so that a pumping plant could be operated at 100 per cent load factor for six months, then 7½ horsepower would do the work, making the table as follows:

Acre Ins. Per Season.	Monthly Per Cent of Total Delivery.	Acres Covered.	Total Season Power Cost.	Cost Per Acre Season.
18	16.66	180	$333.95	$1.84
20	16.66	165	330.95	2.00
24	16.66	135	330.95	2.45
27	16.66	122	330.95	2.71
30	16.66	105	330.95	3.16
36	16.66	90	330.95	3.68

Referring to the load factor tables and curves, it will be seen that, owing to the demand for more water, during the months of July and August the installations must necessarily be about 30 per cent larger than if water were used in the same amount constantly during the season, which would result in the customer getting water on the land somewhat cheaper and argue for the universal adoption of a flat power rate, but these conditions evidently do not exist.

The water duty, power required and per acre costs shown do not take into account distribution losses in the irrigation systems, which losses are entirely in control of the customer; and in modern, well constructed systems—especially the small ones—are negligible.

The power costs per acre specified in tables are easily capable of being obtained and maintained under the power rate quoted and are figured for a plant of 1000 horsepower delivering 100 ft., and the small plant of 10 horsepower at 50 ft., because these two lifts

are about what generally exist in the different sizes of plants. And while I admit that in case of the great majority of plants in operation today the per acre costs have greatly exceeded these specified, it has been wholly on account of the inefficiency of apparatus used. And to give an example of the difference of costs of power per acre per season (under the rates herein mentioned) of efficient and inefficient apparatus under a 50 foot lift, take "A" for instance whose over-all efficiency is 57 per cent and "B" whose over-all efficiency is 30 per cent, then "A" pays $3.29 per acre season for 27 acre inches delivered in the right season ratio, and "B" pays $6.25, or nearly double.

[To be continued.]

ELECTRICAL ENERGY IN MANUFACTURE OF FERTILIZERS.

The visit of Dr. Samuel Eyde to the Coast brings up at once the present status of the electric fixation of atmospheric nitrogen, and the use of calcium cyanamid and calcium nitrate on soils. The Bureau of Soils of the Department of Agriculture has collected in bulletin No. 63 a comprehensive summary of this most profitable and promising field for future utilization of gigantic water-powers as an aid in replenishing depleted soils.

For many years it has been the aim of inventors to devise means of utilizing the vast store of nitrogen in the atmosphere. Two practical motives have been operative:

First, the enormous development of engineering and structural work calls for a largely increased manufacture of high explosives at a moderate price. Incidentally the modern art of war calls for explosives of high power in no mean amount. For these purposes oxidized nitrogen in some suitable carrier seems to be accepted as the most practical basis agent.

Second, the more or less rapid development of intensive methods of agriculture throughout civilized lands warns us that a reliable supply of nitrogenous soil amendments or fertilizers must be found. Up to the present our main supplies of nitrogenous fertilizers have been natural deposits of niter (principally Chilean saltpeter), ammoniacal waste liquors of gas works and coke ovens (ammonium sulphate), animal refuse and slaughterhouse products, such as tankage, animal manures including night-soil, and green manures of leguminous and other crops. None of these has yet been exploited to its full limit, and to predicate the adequacy of any or all of them for the future is to speculate aimlessly, for there are not sufficient data to justify confidently any computations. The fact remains, nevertheless, that experience is showing so high a cost for nitrogen in the common available fertilizers, many of which also present undesirable features in their handling, that new nitrogenous fertilizers are desirable.

The desire to obtain a cheap and inexhaustible supply of nitric acid, primarily for the manufacture of high explosives, and secondarily to augment the world's supply of available nitrogenous fertilizers, has led within the last decade to the commercial production of two substances well suited to the latter end. These are basic calcium nitrate and calcium cyanamid. Both have been repeatedly tested as practical fertilizers, and in both cases favorable and unfavorable results are on record, as is true of any fertilizers. On the whole, however, they seem to have won a definite recognition as valuable fertilizers.

The manufacture of these products on a commercial scale depends on an ample and cheap supply of lime or limestone and on a cheap source of power, for both require the employment of high-power electric current. The first condition can be met with relative ease. The second is really the limiting condition for economic production. So far cheap water powers have almost exclusively claimed consideration, but as cheap water powers in accessible localities are rapidly disappearing, there appears to be a tendency to consider the possibilities of "producer gas" where it is developed in sufficiently large and continuous quantities in connection with some other industry, as for instance in large steel works.

The first important commercial production of nitric acid from atmospheric nitrogen was at Niagara Falls, by the Bradley-Lovejoy process. Essentially the process consisted in passing air, or air somewhat enriched with oxygen, through a rapidly alternating high-tension electric spark. Fortunately for the stability of our atmosphere, the "kindling temperature" of nitrogen is very high, else a thunderstorm might destroy the world. With the sparks obtained by the Bradley-Lovejoy method, some oxidation of nitrogen was secured, and by absorbing the burned or sparked air in water nitric acid was obtained. The life of this factory was, however, brief. About the same time the Birkeland-Eyde process was developed at Notodden, in Norway, where a much cheaper water power and large supplies of limestone were available. This process differed from that of Bradley and Lovejoy in that the electric spark was spread out by being developed between powerful magnets, thus giving a much larger surface of action upon the current of air which was forced through the spark. The sparked air was then absorbed in water by means of towers similar to the ordinary Gay-Lussac towers of the sulphuric-acid factory. In this way a low per cent nitric acid could be manufactured under exceptionally favorable circumstances. But it was soon found advisable, from a commercial point of view, to absorb this acid in an excess of lime or lime water, thus producing a mixture of lime and lime nitrates and nitrites, of which the principal component seems to be the definite compound

$$2CaO\ N_2O_5\ 3\tfrac{1}{2}H_2O$$

a true basic lime nitrate. This substance soon found favor as a nitrogenous fertilizer, especially in Northern Germany, and practically all the product of the Notodden factory has gone to that locality for fertilizer purposes, although it is generally understood that it was the intention of the operators in Notodden to develop the method to the point where a concentrated nitric acid could be commercially prepared for the manufacture of high explosives.

Still more recently another method has been developed for the production of nitric acid by the oxidation of nitrogen, this method being controlled by the well-known manufacturers, the Badische Anilin und Soda-Fabrik. In this process a continuous arc is produced in a long tube by first bringing electrodes together and then gradually moving one of them along the tube

while the other remains fixed at one end of the tube. The current of air instead of being passed through this arc is passed around it through the tube by being forced in at an angle to the main axis of the tube. It is said that the arcs used in this process vary from 30 to 50 feet or more in length, and are maintained continuously for days or even months at a time. The gases passing from the tube are absorbed in water and give a much higher concentration than those produced by the Birkeland-Eyde process, some of the statements appearing in the current descriptions claiming that an acid as high as 30 per cent is formed.

Another method for producing nitric acid by the burning of air which has been attracting some attention recently, and which appears to contain great promise, is that known as the Rankin process. The peculiar features claimed for this method are that they use a "fat" spark produced by a current of far lower tension than that employed in the Bradley-Lovejoy or the Birkeland-Eyde processes, and employ electrodes of peculiar construction, the cathode being a hollow iron contrivance through the interior of which is passed continually a current of cold water, while the anode is a substance of secret composition which is said to ionize the air particles as they approach the spark. The claim is made for this process that the solution obtained by absorbing the gases in water passed through a specially constructed cooling device is a nitric-acid solution of a considerably higher concentration than that produced by the other processes. It is not possible at present to state how far the Rankin method has become a commercial one, as in many of its details it is what is known as a secret process, and the operations of the company controlling it are not accessible to the public. It can be stated, however, that marketable quantities of high-grade nitric acid have been produced by this process, and that it, like the others described above, is mainly dependent upon the procurement of cheap power.

An interesting feature of the work of this company is that they at one time proposed to utilize their acid in the manufacture of super-phosphate, which would, of course, contain basic calcium nitrate instead of gypsum.

Lime nitrogen or calcium cyanamid utilizes the atmospheric nitrogen in a manner which, chemically at least, is distinctly different from the processes described above. Calcium carbide is made by heating in an electric furnace a mixture of lime and carbon, or some highly carbonaceous matter, such as coke screenings, tarry residues, etc. If, now, the process is carried further in an electric furnace of special construction, and a current of nitrogen or air rich in nitrogen is passed over the highly heated carbide, a chemical reaction takes place. If the heat be sufficiently high and prolonged, calcium cyanide is formed,

$$Ca(CN)_2$$

but if a somewhat lower temperature be maintained, the product is mainly calcium cyanamid.

$$CN_2Ca.$$

The calcium cyanide is a valuable starting point for the production of compounds. Calcium cyanamid finds a number of uses in chemical industry; as, for instance, a starting point in the production of guanadin derivatives, use in case-hardening steel, etc., but is mainly used as a fertilizer. It has been claimed as an advantage to the process that Messrs. Frank and Caro, the original inventors, have further devised a scheme for producing nitric acid, starting with cyanamid as the raw product and employing a contact method, but so far the details of the process have not been made public, and it does not as yet seem to have been employed in a commercial way.

What takes place when calcium cyanamid is added to the soil has not yet been definitely settled. The raw substance appears to be toxic to most of our common-crop plants, but it more or less quickly undergoes decomposition and changes in the soil, probably with the production of nitric acid through bacterial and other activities, and thus becomes available to the plants. It should be observed, therefore, that calcium cyanamid is not to be regarded as a substitute for or as playing the same role in the soil as sodium nitrate, but rather as simulating the ammoniacal salts, tankage, etc. Its advantages over these substances as fertilizer are its cheapness, ease of handling, storage, and generally better mechanical properties. In these respects it seems to have a distinct advantage over the basic calcium nitrate produced by the various processes of oxidation of nitrogen, for the latter is a markedly hygroscopic substance, the handling thereof and the selection of proper containers therefor being important problems in its commercial exploitation.

EXPANSION OF NITRATE INDUSTRY.

The current consular reports give interesting figures of the present status of the nitrate industry in Chile. In view of the discussion elsewhere in this issue on electrical methods for production of calcium nitrate this data will prove valuable in comparison and is as follows:

The outlook for the nitrate business promises exceptionally well both in price and consumption. The past nitrate year ending June 30 was prosperous, with a production of 2,469,000 tons, against 2,459,000 tons for the previous year, and on a rising market of fully 10 per cent for the year. With the new nitrate works to be opened it is estimated that the output for the nitrate year ending June 30, 1913, will show a marked increase, since the visible supply on June 30, 1912, was 33,000 tons less than at the same date last year.

The world's consumption of nitrate for the last nitrate year broke the record by 36,000 tons and exceeded the production. Apparently there has been quite a decline in the consumption of nitrate of soda in the United States during the past three years, while other parts of the world show good increases, as may be seen from the following table:

Countries.	1910 Tons	1911 Tons	1912 Tons
Continent of Europe	1,530,000	1,585,000	1,711,000
United Kingdom	118,000	129,000	132,000
United States	516,000	535,000	503,000
Other countries	78,000	85,000	114,000
	2,242,000	2,324,000	2,460,000

WATER POWER PERMITS.

The United States government has formulated rules and regulations governing the acquisition of power sites under the act of February 15, 1901. Western land offices are in receipt of the regulations approved August 24, 1912, the same comprising a pamphlet form of some 20 pages.

JOURNAL OF ELECTRICITY
POWER AND GAS

STATEMENT OF THE OWNERSHIP, MANAGEMENT, ETC., OF JOURNAL OF ELECTRICITY, POWER & GAS, Published Weekly at San Francisco, required by the Act of Congress of August 24th, 1912.

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Signed. A. H. HALLORAN.

Sworn to and subscribed before me this 3rd day of October, 1912.

(Seal.) J. W. COOK, Notary Public,

In and for the county of San Francisco, State of California.
(My Commission expires Dec. 20th, 1915.)

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895.
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CONTENTS

Investigations on Synthetic Nitrogen Products

The possible use of synthetic nitrogen products as fertilizers in varying soils is of commercial importance to the agriculturist and to the power expert. To the agriculturist it means a new replenisher of depleted soils to replace the possible exhaustion of the present natural supply. To the power expert, it means an enlarged utilization of vast natural water powers.

It is imperative that experiments be undertaken in the West to determine the comparative merits of nitrate of soda, the natural fertilizer found in nature, and nitrate of lime, the recently invented synthetic nitrogen product now proving so profitable in Norway as an electrical process for utilizing the nitrogen of the air.

Chas. B. Lipman, soil expert of the agricultural experiment station at the University of California, is preparing to undertake such investigation as outlined above with samples shipped from the Eyde plant in Norway. Hitherto, Mr. Lipman has made noteworthy and original strides in investigations of the fixation of atmospheric nitrogen by means of plant life, consequently the results of his new labors will be watched by the hydroelectric fraternity with the keenest interest.

Gigantic Powers for Nitrogen Products

Of intense interest to Coast hydroelectric companies is the present visit to Seattle and San Francisco of Dr. Samuel Eyde of Christiana, Norway. Dr. Eyde is the head of the nitrogen industries of Norway, and the inventor of the system of utilizing nitrogen from air, which is now in practical use in Norway.

At present the world's supply of nitrates used in fertilizers are mined in the saltpeter beds in Chile. Rich and extensive as these deposits are, nevertheless, experts declare the present rapid rate of consumption will exhaust the supply within the next sixty years. The chemical combining of free nitrogen of the air in commercial quantities has for years baffled scientists. Indeed, the process so efficiently brought into action by certain organic growths has been enviously sought after for a century. A hundred years ago the electric spark was first found to aid in the formation of chemical products from the inert nitrogen of the air. As a commercial success, however, it was not until 1903, that Dr. Eyde employed two men in the first production of nitrogen products by his process. Today the Norway plant at Rjukanfoss employs 1000 men and has a production of 70,000 to 80,000 tons of nitrate of lime annually, together with thousand of tons of by-products.

Synthetic nitrogen fertilizers are produced under the Eyde system by the use of fans and the driving of the air through the so-called Birkeland-Eyde oven, where it is heated by an electrical flame. The oxygen and nitrogen are there combined in water to make nitric acid. With calcium carbonate, which may be found in immense deposits in the West, nitrate of lime is there formed which, in many finer fertilizing qualities, even excels the famous sodium nitrate found

in Chile and now universally used for aid to plant growth. Aside from nitrate of lime, the air plants of Norway produce other valuable nitric by-products, including ammonium nitrate, wrich is manufactured for explosives; nitrite, which is used in the manufacture of aniline dyes; and concentrate nitric acid, which has many uses in the chemical industries.

The Norsk Hydro-elektrick Kvoelstofak-tieselskab, the company which operates the plant utilizing Dr. Eyde's process and which has a capital of $30,-000,000, is making improvements and adding to the annual production as fast as possible.

A site is now being looked into as a possible base to supply the products to America and the countries bordering on the Pacific. Four things are necessary for the ideal location—abundance of cheap power, water, calcium carbonate and a profitable market. It is stated that a plant of proportions desired would utilize 200,000 horsepower and employ a thousand men. It is certainly true that if any place in the world cheap power is to be found, it is in the great water powers of the West. Water necessary as an absorbent in the making of nitric acid will thus be simultaneously available in required quantities. As for calcium carbonate, nature has lavishly shown her hand in distributing these deposits in unlimited supply in our coast commonwealths. The market for these products finally, is unquestionably to be found in our Western Empire, where agricultural pursuits will eternally necessitate the fertilizing of depleted soils in years to come. A ready market, too, will be found among the isles of the Pacific and throughout North and South America, so soon to be entirely approachable via Pacific Coast ports and the Panama Canal.

Summing up the entire situation, then, it would seem that ideal conditions are found here in the West for utilization of gigantic powers in the manufacture of synthetic nitrogen products. The West would welcome Dr. Eyde and his installation. But whether or not his particular investigation will prove it to be a wise and feasible move to locate a plant in the West, at present is of small moment, for the fact remains that someone sooner or later will realize the opportunities presented and the unquestioned future market here to be found. Another new and bright sky is thus before tne West for the utilization of its gigantic natural blessings in the way of unsurpassed water powers.

Electric Power vs. the Human Pump.

It is surprising to note the unprecedented growth in the utilization of electrically operated pumps during the past year in the arid sections of the West. Even in those districts where water is as a rule plentiful, due to kindly and seasonal rains, the farmer finds it to his advantage to have a "friend in need" in the way of the electrically operated pump ever ready for an emergency or a chance disappointment in the foretelling of approaching rains by the weather man. A striking illustration of this gigantic growth is seen from the present load conditions of such coast companies as the Pacific Power & Light Company of Oregon, the Pacific Gas & Electric Company and the Great Western Power Company of central California, and the Southern California Edison Company in the southern section of that commonwealth. In each of these companies, whereas two years ago the pumping load in rural communities was an inconsiderable item, today no less than 25,000 h.p. of installed capacity in electrically operated pumps are to be found, the average unit being from 10 to 20 h.p. Other companies could equally well be mentioned in the list above. To show the extreme limit of application in the pliable, electrically operated pump, the Mt. Whitney Light & Power Company in the upper San Joaquin Valley finds that it can profitably supply power to one of its rancher consumers to lift water, for irrigation purposes, a total height of 476 ft. vertical.

In the present reawakening of China visitors returning from that ancient civilization are loud in their praise for many economic agricultural wrinkles widely in vogue there, but wholly unknown in this country. Many had previously heard of the river boats propelled in their native streams by the Chinese. The classic stern wheels of these boats are often actuated by the Chinamen themselves climbing treadmills attached to the stern wheels. Few, however, had dreamed of the application to irrigation of this method of raising water though this latter application has antedated the former in China probably by hundreds of years.

Let us for a moment discuss this method of power generation in this ancient civilization, which has produced such eminent teachers, religious leaders and inventions. According to Harrington Emerson, experience has thoroughly demonstrated in the treadmills of British prisons, that year in and year out, an average human being operating a treadmill can climb 8640 ft. per day. As the average human being weighs 150 lb., this is equivalent to 1,296,-000 ft. lb. per 24 hr. One horsepower in. 24 hr. will produce 47,520,000 ft. lb. of energy. Calling now, our new power unit, the "chink," it is seen at a glance that 36.6 "chinks" are equivalent to a horsepower. In China today is to be found perhaps the lowest wage scale in existence. In order, then, to give the treadmill pumping plant its most economic cost of power production, let us compute costs of operation and power generation on the basis of 10c per day for human labor. A horsepower of energy would thus cost $3.66 per day or $1336.00 per year. In the arid west, power may be had in abundance for steady pumping operations at $50.00 per hp. per yr. In the ultimate it will undoubtedly prove true that $25.00 per year or less will prove profitable. But at $50.00 per hp. per yr., it is seen that electric power may be delivered at less than one twenty-fifth the cost of production by the cheapest labor on earth.

Compare now the wage conditions of the two types of men directing the generation of power as set forth above—the one gets 10c per day for his labor, the other $3.00 per day or more; the one represents a limited supply of human endeavor, which might by human intrique be monopolyzed, the other is bounded by the limits of the heat and warmth of the heavens, and only the Almighty himself can ever be said to control the supply.

PERSONALS.

H. B. Day, a telephone official of San Diego, is a recent San Francisco visitor.

S. C. Gillespie, valuation engineer of J. G. White & Co. of New York, is visiting Los Angeles on business.

R. M. Alvord, local supply manager of the General Electric Company, has returned to the San Francisco office after an extensive Eastern trip.

W. L. Goodwin, manager of the Pacific States Electric Company, has been spending a week at the Los Angeles branch, where business is very good.

Thomas A. Cashin has taken up his duties as superintendent of municipal railways, in connection with the Geary-street electric road, which is nearing completion.

J. E. Crilly, who is connected with the office of the Holabird-Reynolds Company, is en route to Honolulu on the steamer Sierra and will spend a well-earned vacation in the Hawaiian Islands.

R D. Holabird, president of the Holabird-Reynolds Company, recently returned to San Francisco from Seattle and **E. J. Dwyer**, of the same firm, is spending a few weeks at the northwest branch house.

Robert Reid has recently resigned his position with the Pacific Gas & Electric Company and is returning to the Hawaiian Islands, where he will be engaged as power superintendent in a small hydroelectric plant.

H. M. Hepburn, general manager of The Hawaiian Electric Company, Inc., recently sailed for Honolulu, after having spent some time in visiting Eastern central stations and electric manufacturing works while gathering information.

Wynn Meredith of Sanderson & Porter, who recently returned to San Francisco after making an inspection of the progress of the work on the General Petroleum Company's pipe line, will leave for Victoria, B. C., early next week.

A. J. Turner, of the commercial department of the Great Western Power Company, has been elected secretary of his university class, to fill the position made vacant by the recent deplorable death of his classmate, Jas. H. Wise. Mr. Turner graduated from the University of California in 1903.

A. W. Bullard, general manager of the Great Western Power Company, accompanied Mortimer Fleishhacker, president of the same company, and H. P. Wilson, vice-president of the Western Power Company on an inspection trip to the Big Meadows dam and the power plant on the Feather River during the past week.

Gerald Deakin, formerly chief engineer of the Bay Cities Home Telephone Company and recently automatic plant engineer of the Pacific Telephone & Telegraph Company, has left for New York on his way to Europe to take up the development of automatic telephone apparatus for the Bell Telephone Manufacturing Company of Antwerp. Mr. and Mrs. Deakin expect to reside in Europe for the next three to five years.

Dr. Samuel Edye, inventor of the Birkeland-Eyde process of electrically forming synthetic nitrogen products from the air, is a recent San Francisco and Seattle visitor. Dr. Eyde is visiting the west with a possible view of establishing a plant similar to his Norway installation. It is said that such a plant would utilize 200,000 horsepower and employ 1000 men.

M. L. Scoby and **B. Badrian**, with the Pacific States Elecric Company, have returned to San Francisco after spending some time in charge of an attractive exhibit of various electric appliances at the State Fair at Sacramento, and, later, at the Stanislaus County Fair at Modesto. A gold medal was received at Sacramento and a blue ribbon, for the best exhibit at Modesto.

R. S. Buck of Sanderson & Porter's Pacific Coast branch office, is visiting New York City at the request of the municipal authorities so as to be of assistance in some adjustment in connection with the East River bridges. Buck was chief engineer of the Department of Bridges during the construction of the Blackwells Island bridge and of the Manhattan bridge. He also planned four bridges at Niagara Falls.

F. G. Baum, of F. G. Baum & Company, who has been for some years consulting engineer for the Pacific Gas & Electric Company, will, in future act for that corporation in a larger capacity. It is understood that he will have special charge of the construction of the Lake Spaulding dam and of the tunnel work of the Bear River, or South Yuba development. Mr. Baum recently returned to San Francisco after visiting South America.

J. L. Crider, who has been general superintendent of construction with J. G. White & Co. for the Oakland and Antioch Railway work, is now in general charge of the construction on the Oakland, Antioch and Eastern in addition to the above-mentioned road. **C. H. Quimby** has joined the Pacific Coast force of J. G. White & Co. as assistant to J. L Crider, in following up the general construction work on the Oakland and Antioch. He recently arrived at San Francisco from the East, where he has been connected with important engineering work.

E. B. Bumsted, who was formerly connected with the engineering department of the Stone & Webster Engineering Corporation and the Stone & Webster Construction Company, has been appointed vice-president of the Oro Electric Corporation and placed in charge of the departments of operation and construction. The company has been increasing its force, in anticipation of expending more than $5,000,000 on a new hydroelectric plant within the next two years. It is the intention of the management to begin construction work at once on the new Yellow Creek development of 60,000 h.p. The plant, located at the junction of Yellow Creek and the north Fork of the Feather River, will use a high head of water exceeding 2000 feet. Mr. Bumsted is well equipped for this work, having been connected with hydroelectric enterprises for fourteen years. He was connected with the construction of the St. Lawrence River Power Company's large plant and was afterwards general manager.

OBITUARY NOTE.

Lorenz Davenport Hitzeroth, who was long connected with the electrical business at San Francisco, died October 1, leaving a wife, Mary Hitzeroth, and a son, Lorenz C. Hitzeroth. Funeral services were held October 3, at Mission Masonic Temple, under the auspices of Mission Lodge, No. 169, F. & A. M.

TRADE NOTES.

The Westinghouse Electric and Manufacturing Company has been awarded the contract for the main generators and other alternating current apparatus for the Pacific Gas and Electric Company's two power houses that are being constructed to utilize the waters of Bear River in connection with the Lake Spaulding reservoir. The specifications call for 4 water wheel-type generators, each rated at 12,500 k.v.a. A Westinghouse representative says that the design of the machines has been perfected to a point where they can guarantee a runaway speed of twice the normal speed. Each water wheel is rated 8500 h.p. and of the double overhung type, making 17,000 h.p. per unit.

The Pacific Gas and Electric Company also ordered from the Crocker-Wheeler Company two railway motor generator sets, one of which is to be installed at Oakland and the other at Sacramento. The requirements indicated by the specifications are very high. Each machine has a capacity of 1000 kw. On the primary the voltage is 11,000, 60 cycles, at 514 r.p.m., while the secondary is 600 v., direct current.

ELECTRICAL CONTRACTORS' NOTE.

The General Electric Construction Company was awarded the wiring for the new State Armory at 14th and Mission streets. The cost was estimated at about $8000.

The Newberry-Bendheim Company have about completed the wiring at the Presidio Hospital and have commenced installing conduits in the Standard Oil Building.

P. Decker, who was sick at Thomas' Sanitorium for about three weeks, has improved and returned home.

It is reported that the Tivoli Opera House will go ahead, as a loan has been obtained by the management.

The joint Board of Police and Fire Commissioners ruled at a recent meeting to the effect that in the future metal troughs should be allowed for the outlining of buildings and in Marquises. This is contrary to the rules of the National Board of Fire Underwriters, and really a step backwards. Metal trough was good construction before the day of the conduit and such fittings, but today, with the convenient fittings that the manufacturers have placed at our disposal, it is but a makeshift and favored only by people engaged in the sheet metal business. No up-to-date electrical man would specify anything except conduit work for decorating. With reference to Marquises, the writer sees no objection to enclosing the wires in the frame of a Marquise, as a better job can be done and the life of the Marquise is the life of the job.

The Starr King School will be out for figures in a few days. Architect John Reid Jr. has notified the contractors that the bids will be segregated.

The California State Electrical Contractors' Association is working hard at raising funds to aid their State license law that they expect to bring before the State Legislature this winter.

Fred Fisher's bid of $55,100 was accepted for the general construction contract on the Service Building at the Panama-Pacific Exposition. The Central Electric Company's bid of $1700 was the lowest on the wiring.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

September 28.

The Pacific Gas & Electric Company applied to the Railroad Commission for permission to build a spur track across a county highway in Placer county, to be used in connection with hydroelectric development work.

September 30.

The Railroad Commission set October 16 for the hearing of the induction cases. The Pacific Telephone & Telegraph Company filed four complaints; one against the Sierra & San Francisco Power Company alleging interference with the lines in Santa Clara and Monterey counties; one against the Coast Counties Gas & Electric Company alleging interference in Santa Clara and Santa Cruz counties; and two against the Great Western Power Company alleging interference in the section north of San Francisco Bay. The telephone company requested that the power companies be compelled to move their high-tension wires from 700 ft. to 2000 ft. from the telephone lines.

October 1.

The Railroad Commission rendered a decision establishing a through route and joint rates between the Central California Traction Company and the Atchison, Topeka & Santa Fe Railway Company. The Central California Traction Company operates between Sacramento and Stockton, a distance of about seventy miles, and connects at Stockton with the Santa Fe.

A hearing of importance to telephone users and to telephone companies was set for October 7, at which time the Commission will have under consideration the proposed new system of toll rates of the Pacific Telephone & Telegraph Company.

An order was issued by the Commission granting authority to the Collins Commercial Company to extend wires across Palm street and Bay avenue, at Newport Beach.

October 2.

The Northern Electric Railway Company applied for permission to issue $8,000,000 of 5 per cent bonds, of which $5,500,000 will be sold to complete the company's line from Sacramento to Vallejo. The balance will be reserved for such issuance or exchange as may later be determined.

The Commission granted the application of the Mt. Whitney Power & Electric Company to put into effect a new form of meter contract for power, providing for a minimum of $24 per year.

R. H. Gaud and the Santa Barbara & Suburban Railway joined in a petition asking that the former be allowed to transfer to the latter his street railway franchise in Santa Barbara. The Santa Barbara & Suburban Railway Company also asks for a certificate of public convenience and necessity allowing it to operate under this franchise.

The Great Western Power Company applied for a certificate of public convenience and necessity to exercise franchise rights in the towns of Suisun, Fairfield and Dixon, and for the sale of electricity.

ELECTRICAL DEVELOPMENT LEAGUE MEETING.

The regular monthly meeting of the Electrical Development League of San Francisco was held October 8th. Considerable discussion took place relative to the inefficient and arbitrary regulations at present in force in San Francisco with respect to electric installations, and particularly the discriminatory laws existing with respect to the use of flexible steel conduit and steel armored conductors. A committee of nine, consisting of Messrs. C. C. Hillis, L. Levy, L. R. Boyton, G. I. Kinney, C. C. Davis, W. W. Hanscomb, N. W. Reed and a representative from each of the Central Stations, was appointed to take up the subject with the city electrician and if necessary the Board of Supervisors, looking toward a revision of the present laws and consultation on any future municipal legislation.

Messrs. A. W. Bullard, E. B. Strong and Stanley Walton were appointed delegates to the Boston Electric Show September 28th to October 26th.

The subject of consolidation of the various electrical organizations, i.e., Sons of Jove, Energy Club and Electrical Development League, was considered and a committee of three consisting of Messrs. Holberton, Vandegrift and Halloran appointed to consider the advisability and possibilities of such action.

At the conclusion of the business session the members were treated to an interesting paper on "Readiness to Serve Methods" by Ross B. Maters of the Great Western Power Company.

JOVIAN LUNCH CLUB AT PORTLAND.

Forty members and guests met at the Hazelwood Thursday, the 3d, for 12:15 p. m. lunch. The speaker of the day was F. J. Lonergan, who gave an exceedingly interesting talk on "Defense of the Portland Railway, Light & Power Company's position in regard to the franchise granted by the City Council to the Northwestern Power Company."

OREGON SOCIETY OF ENGINEERS.

The Oregon Society of Engineers, through their legislative committee, of which F. D. Weber is chairman, is making a determined protest against the passage of a "special permit" by the City Council of the City of Portland, Oregon, for the addition of another story to the three-story frame building located at the northwest corner Fourteenth and Market streets, which would be in direct violation of Section 119 of the Building Code of the city.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

WIRING REQUIREMENTS AT PORTLAND.

(Continued.)

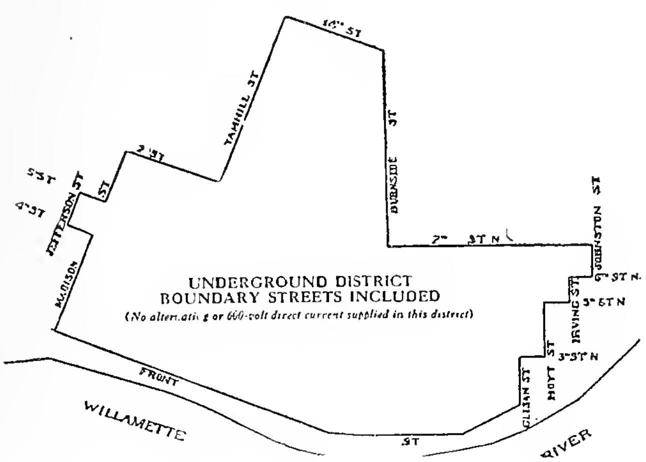
Underground District.

The Portland Railway, Light & Power Company operates a 3-wire direct current distribution system of 120 and 240 volts approximately (Edison Standard). (No alternating current or 500-volt direct current can be supplied in the underground district.)

Wiring.

(See general requirements, Division 1, Sections A, B and C.)

(a) In the underground district, the company will, in most cases, at its own expense, install, in metal boxes and conduit, in the basements of the buildings, all switches, cutouts and wires up to the meters, unless the arrangement or



occupancy of the basement will not permit the location of the meter board at the point of service entrance, in which case the wiring contractor will be required to extend the service mains, at the building owner's expense, in metal conduit from the point of service to the meter board, which in most cases will be furnished and installed at the desired point by the company, together with all wiring on the board ahead of the meters. If the building has no basement or is located east of the high-water line of 1876 and 1890, some different and special method of making the service connection will be pursued.

(b) In any case where the company brings its service into the building, it will provide and install in its switch cabinet the elevator motor switch and cut-out, and the exit light switch and cut-out, as called for by sections 723½ and 788 of the Building Code of the City of Portland. All circuits leaving this switch cabinet must be carried in continuous metal conduit to the meter board, except that where necessary to install pull boxes, approved outlets with blank metal covers may be used.

(c) Owners, architects, contractors and others are herewith advised and warned that the company must be notified in writing when plans are being drawn for any building, so that its engineers may co-operate with the proper party in deciding on the point of service entrance and the location of the meters.

The company also requires this advance notice so that it may be prepared to install the above mentioned apparatus without delay when the proper time to do so arrives.

The company will not be responsible for delay in making the service connections when such notice is not given, and reserves the right to refuse to supply service unless the above requirement is complied with.

(d) Attention is called to Board of Fire Underwriters' Electrical Circular No. 17, of October 22, 1909, of which the following is an extract:

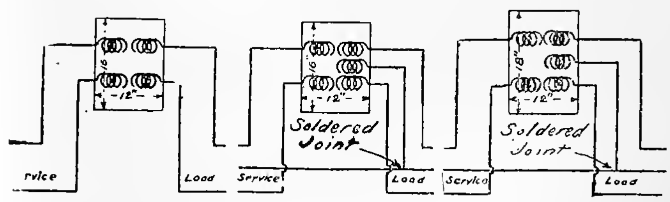
"All switches and fuses in basements to be placed in approved cabinets, as they are generally exposed to mechanical injury, the piling of stock, etc.

"A fuse on the customer's service is entirely unnecessary where the Portland Railway, Light & Power Company has installed one directly ahead of his (the customer's) meter.

"We suggest that the cabinet containing the customer's service switch be placed on the basement ceiling wherever feasible."

(e) Customers' switches must not be installed on company's meter board, and customers' conduit should terminate at top of board and the wires be carried down to the meter in loom. The loom to be fastened to the board with metal straps.

DIAGRAM OF WIRING FOR METERS IN OVERHEAD DISTRICT
(This also applies to Supplementary Meters in the Underground District)



Dimensions give size of meter board to be installed.

(f) All meter loops installed by the wiring contractor for supplementary meters must be arranged for left-hand service, as shown.

Motors.

(a) Motors of less than one horse power must be a 110-120 volt direct current type, except as provided in (c).

(b) Motors of one horse power and over must be a 220-240 volt direct current type.

(c) Where the total connected load is one horse power or more, the voltage of all motors may be 220-240 volts.

(d) Where the total connected load is less than two horse power the motor or motors may be connected to the lighting meter.

If the total load is two horse power or over the wiring must be arranged for a separate meter for the motors.

Batteries.

In wiring for installations in which the load will consist of storage batteries which are to be charged direct from the company's 120-240 volt direct current Edison system, the wiring connections must be arranged and made, so that, at any instant, one-half (½) of the load will be connected to the positive side of the 3-wire system, and the other half of the load to the negative side, thus providing a balanced load. To insure as far as possible that the load will be connected as specified above, a 3-wire bus must be run around the charging rack or platform, and alternate receptacles for taps to batteries, must be connected to the positive and negative busses, respecitvely.

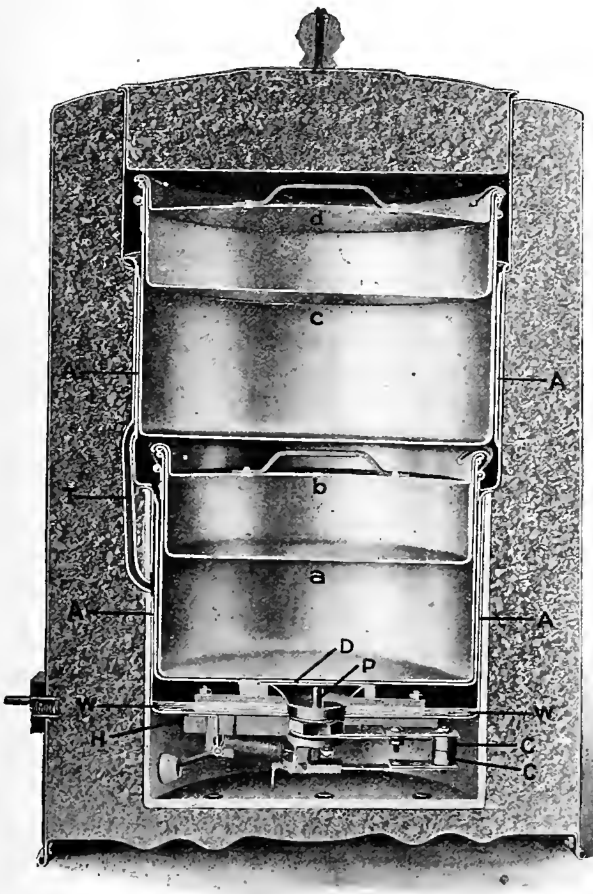
The company reserves the right to refuse to supply service unless the above requirement is complied with. It also reserves the right to discontinue service to an installation that has been connected, if the batteries are not connected as specified above.

INDUSTRIAL

AN ELECTRIC FIRELESS COOKER.

The Berkeley Electric Cooker Company had an interesting exhibit at the recent convention in Berkeley, Cal., of the League of California Municipalities. This exhibit is shown in the illustration. In this illustration is seen the picture of one of the electric cookers which without perceptible deterioration has already been in continuous operation for a year and a half.

This improved electric cooker consists of a double-walled copper vessel (marked A) with a small quantity of water in the bottom (marked W), and the switch mechanism operated by pressure of steam on a diaphragm (D), which pushes the pin (P) and opens the switch contacts at C, as shown in the illustration. The water is heated by the nichrome heating element (H), and the steam from this water completely fills the interior of the steam oven. In this way the distribution



Sectional View Electric Cooker.

of heat is accomplished. When the pressure of the steam rises to about ten pounds per square inch, the spring in the diaphragm (D) is overcome and it drives the switch contact open with a quick break.

Food is placed in the compartments A, B, C and D, and an entire meal may be cooked at one and the same time.

The stove is economical in cost of operation; automatic in its temperature control; without adjustments in controlling mechanism; made with an efficient heat conducting and distributing system between the electrical heat units and food receptacle, and made of enduring material that will stand continuous use for over a long period of time.

With such a device one may cook food by a process that is convenient, clean, efficient and economical.

FIVE NEW EDISON MAZDA LAMPS.

For 100-130 Volt Circuits.

Previously the only round bulb Edison Mazda lamps available for this circuit were the 15, 25, 40, 60, 400 and 500 watt sizes. On October 1, 1912, the General Electric Company added two new intermediate sizes, namely, the 100-watt and 150-watt sizes. This addition gives the user nearly the same wide range of sizes now available in the standard, or pear-shaped, bulbs.

Concentrated Light Source Mazda Lamp.

Another new lamp, whose successful production marks a decided advance in the manufacture of metallic filament lamps, is the Concentrated Light Source Edison Mazda Lamp, also standardized October 1st. This lamp is equipped with a concentrated filament and will be used on 100-130 volt circuits wherever a concentrated light source is desired, especially in projecting machines in homes and for general advertising purposes. The difficulties overcome in designing this lamp can be appreciated when one considers that a standard straight bulb Mazda lamp for this voltage would require a filament approximately three feet long. In order to obtain the necessary concentrated light source in the new lamp, this length of drawn wire filament is formed into a helix of small diameter somewhat resembling a closely coiled spring. This "spring" is then mounted or coiled together in a space approximately ½ in. each way, thus giving a greatly concentrated light source. The lamp operates at the high efficiency of 1.23 watts per mean horizontal candle power. It is designed to give a life of approximately 250 hours at rated efficiency. The round bulb, known as the G-30, is 3¾ in. in diameter and 6⅛ in. over all. Because of its concentrated light source, this lamp is especially adapted for use with either a parabolic reflector or a lens in projecting machines and for advertising purposes.

For 200-260 Volt Circuits.

Formerly the only round bulb Edison Mazda lamps available for this circuit were the 40 and 60-watt sizes. On October 1, 1912, the General Electric Company added two other sizes, namely, the 25 and 100 watt. Where round bulb lamps of this voltage are required the addition of two new sizes gives users a widely useful range of sizes from 25 to 100 watts, inclusive.

OREGON ELECTRIC RAILWAY COMPANY CATENARY.

In 1907 the Oregon Electric Railway Co. constructed their present main line connecting Portland and Salem, a distance of approximately 50 miles. A 71-mile extension from Salem to Eugene is now being built. Fig. 1 shows a view of the overhead construction on which catenary is used throughout. The original installation used a design of catenary hanger to support the trolley wire from the messenger wire consisting of a three-screw Detroit clamp, a ½-in. hanger rod and a malleable clip to grip the messenger wire, making a rigid hanger. However, for the extension, the hanger shown in Fig. 2 and designed by L. B. Cramer, electrical engineer of the company, is used and it has proved so satisfactory that it has been adopted as standard for all future work. The design consists of a ⅛ in. x 1 in. hanger strap formed into a loop at the messenger end so that it can be hooked over the messenger wire but can not unhook after the trolley clamp is installed. The loop is 3 in. long, permitting vertical movement of the trolley wire and thus eliminating hard spots, the trolley wire practically floating on the trolley wheel. The trolley clamp consists of two malleable castings held together by a ½-in. machine bolt which also passes through the end of the hanger strap. In tightening this bolt, the clamping jaws are

caused to grip the trolley wire. These clamping jaws are made very thin so that they cannot be struck by the passing trolley wheels. The complete hanger is very simple and light, yet strong and easily installed. On certain stretches of track, speeds of from 60 to 65 miles per hour are attained and there is no trouble with the wheels leaving the trolley wire nor is

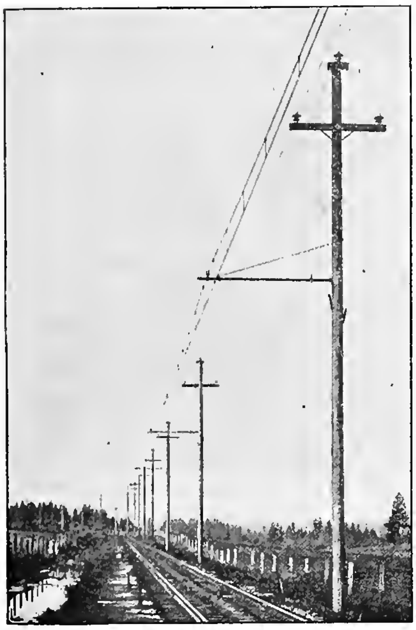


Fig. 1.

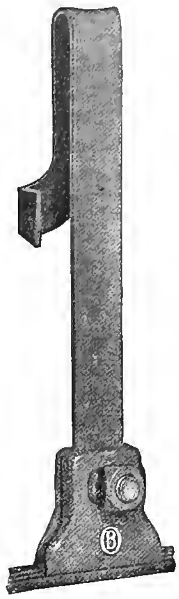


Fig. 2.

there any trouble from sparking, although the trolley voltage is 1300.

The pole spacing is 150 ft. on tangents except for city work and curves, where 120-ft. spans are used. The catenary hangers are spaced 25 ft. apart on tangents. and somewhat closer on curves. Where the curves are severe, requiring pulloff wires to keep the trolley wire close to the center of the track, a special yoke is used at the messenger end of the hanger to which the bridle pulloff wire is attached. The lower wire of the bridle is fastened to an eye held by the bolt of the trolley clamp. With this arrangement, the trolley and messenger wires are pulled into position but the hanger is still free to travel vertically so that no hard spots are introduced into the trolley wire at pulloff points. The catenary material was furnished by the Ohio Brass Company.

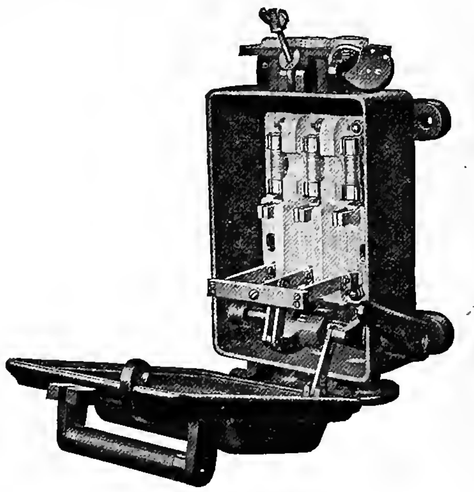
BOOK REVIEW.

Light. Photometry and Illumination. By William Edward Barrows, Jr., B.S., E.E. Size: 6½ in. x 8½ in.; 327 pages; 196 illustrations; cloth binding. Published by McGraw-Hill Book Company of New York and for sale at the Technical Book Shop, 106 Rialto Bldg., San Francisco. Price $3.00.

William E. Barrows, the author of this book, and who is professor of electrical engineering at the University of Maine, has in these pages completely rewritten a previous book entitled "Electrical Illuminating Engineering." The added features of this new publication consist of recent matter of utmost importance which has been gleaned from the transactions of the national engineering societies, articles appearing in the technical press and in addition the author's own revised views. The book is intended for use both in the college and in the field. The summarized, boiled down matter appearing at the end of each chapter relative to more extended discussion elsewhere in its pages will make the book especially useful to practising engineers as a ready reference or summary of important theory involved. The book treats of all phases of illumination and will be found useful to engineers and college students alike.

"D & W" FUSED SWITCH BOXES.

To meet the demand for an improved, combined switch and fuse box the "D & W" Fuse Company have brought out a new line of fused switch boxes for 250 volt d.c. circuits. These boxes are particularly adapted for mill service since they may be permanently locked after the fuses are installed, thereby preventing any tampering with the connections or increasing the capacity of the fuses. At the same time, they can be used as a switch since the circuit can be opened or closed at will by simply moving the lever at the side of the box. When the cover is opened the circuit is likewise opened, which makes it impossible to re-fuse the circuit when the switch is closed.



Improved Switch Boxes.

In designing these boxes they have introduced no complicated mechanism, but have used a very simple but substantial construction which will give indefinite service, since the operation of the switch is not dependent on springs.

These boxes are provided with rubber gaskets which render them positively waterproof provided that the terminal wires are taped in at the bushings or protected by outlet hoods when conduit connections are made. To facilitate installing these boxes removable porcelain bushings are used through which the cable terminals may be readily passed.

TELEPHONE TRAIN DISPATCHING ON THE PORTLAND RAILWAY, LIGHT & POWER CO. ELECTRIC LINE.

The Portland, Oregon, Railway, Light & Power Company has recently placed an order with the Western Electric Company for apparatus to be used in equipping its electric interurban railroad lines with telephone train-dispatching equipment of the latest and most efficient type. In fact, apparatus of another make, at present in use on one of the divisions, is to be dispensed with and the new apparatus installed in its place. One division to be equipped extends from Portland to Cazadero, Oregon, a distance of approximately forty miles, while the other is the Mt. Hood division, extending from Portland to Bull Run, a distance of approximately thirty miles. The dispatcher will be located at Portland. Seventeen way stations in all will be equipped with No. 102-A selector sets, containing the standard Western Electric No. 50 type selector. The circuits, however, are so arranged that an ultimate of thirty-six stations can be equipped with selector apparatus.

The Northwest Steel Company of Portland has been awarded a contract for the steel work on the power house of the Northwestern Electric Company on the White Salmon River, near Underwood, Wash. This power house and the storage dam of solid concrete, 125 feet high and 100 feet thick at the base, are being hurried to completion.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—Wizard Electric Company, $25,-000, shares $10 each, subscribed $50, by C. M. Claussen, W. A. McKay, W. F. Rose, M. Claussen and L. Krull.

ILLUMINATION.

POCATELLO, IDAHO.—The generating machinery of the Pintsch Gas Company was wrecked in a recent fire.

LATAH, WASH.—The town has voted to install electric lights and a water system. Bonds for $11,000 will be issued by the council.

ALAMEDA, CAL.—A resolution has been adopted ordering the clerk to advertise for bids for the installation of electroliers in that district lying east of Park st.

BEND, ORE.—Steidl & Tweet have been granted a franchise for an electric light and power system, water system and electric street railway system in Bond Park and the first and second additions to Bond Park.

SAN JOSE, CAL.—An alternative writ of prohibition has brought the State Railroad Commission into the Superior Court to show that the Commission has power to regulate the gas rates in Palo Alto and contiguous territory. The Palo Alto Council made a rate of $1.25 per 1000 cubic feet, and a temporary restraining order was obtained pending an action for a permanent order.

HOOD RIVER, ORE.—The Hood River Gas & Electric Company has begun work on its electric power plant here, which will be enlarged and have additional machinery installed. The company's dam on Hood river will practically be rebuilt and when completed will afford much additional power. A new 300 horsepower generator will be installed as well as several additional transformers.

SAN FRANCISCO, CAL.—The Railroad Commission has rendered a decision granting authority to the Central California Gas Company to issue additional bonds to the amount of $129,000 and additional preferred stock to the amount of $136,209. The company operates in Tulare County and will use the proceeds from the sale of the securities to purchase the Consolidated Heat, Light & Power Company of Visalia and Tulare, to construct a transmission line from Exeter to Visalia, to construct additions to the gas plant in Visalia and the distributing systems in Visalia and Tulare, to purchase and erect a gasholder in Porterville, to construct a transmission line from Porterville to Lindsay, to construct a transmission line from Lindsay to Exeter, to construct a distributing system in Lindsay, and to construct a distributing system in Exeter.

TRANSMISSION.

KLAMATH FALLS, ORE.—The California & Oregon Power Company has completed its power line from the south into Klamath Falls and connected with the power lines here.

SAN FRANCISCO, CAL.—The Railroad Commission has granted the application of the Mt. Whitney Power & Electric Company to put into effect a new form of meter contract for power, providing for a minimum of $24 a year.

PORTLAND, ORE.—It is announced that the Northwestern Electric Company, recently granted a franchise to enter the city, will erect a substation at a cost of $300,000, and its initial outlay for buildings, etc., will be $1,000,000.

TACOMA, WASH.—Failing in his attempt to dispose of his power site on the White River to the city of Seattle for $1,000,000, P. H. Hohb of this city has made application to the Tacoma City Council for a franchise to sell electric current to the city.

GRANTS PASS, ORE.—It is announced that the California-Oregon Light & Power Company has entered into sufficient contracts with the people of Fruitdale to insure the construction of the distributing line into that neighborhood. Many extensions will be made in that section.

LOS ANGELES, CAL.—President Williams of the City Council and Councilmen Whiffen and Betkouski are to be a special committee to negotiate with the power companies to learn if it would be possible for the city to acquire such portions of the power companies' systems as may be needed to distribute light and power from the aqueduct power plants.

SPOKANE, WASH.—The Washington Water Power Company, operating in the Spokane country, is building a high potential line from its distributing station at Wardner, Idaho, to Pine Creek, two miles southwest, from which point branch lines will be run to the Nabob mine, one mile, and to the Surprise properties, two miles. The line will run through the Bunker Hill & Sullivan ground.

PLACERVILLE, CAL.—The battle of property owners and residents of Placer and El Dorado Counties to forestall the Truckee River General Electric Company in its purpose to use the waters of Lake Tahoe to develop power has culminated in a suit to restrain the company from proceeding with its work. A complaint has been filed with the county clerk on behalf of the Western Company, a corporation, praying that a restraining order be issued against the Stone & Webster Construction Company and the Truckee River General Electric Company. The Western Company is a corporation heavily interested through ownership and mortgages in land fronting on Lake Tahoe. Wm. S. Tevis is president of the corporation.

TRANSPORTATION.

SAN FRANCISCO, CAL.—The State Railroad Commission has rendered a decision establishing through and joint rates between the Central California Traction Company and the Santa Fe.

LOS ANGELES, CAL.—Plans for new terminals for the San Pedro street line of the Pacific Electric on property back of the present depot, have been completed by Assistant Chief Engineer Johnson.

LA GRANDE, ORE.—Grand Ronde citizens are much pleased over the prospects for an electric line which is to girdle the valley. A survey extending from La Grande to Cove, thence to Imbler and back via Alicel Island City having just been completed.

ASTORIA, ORE.—Surveyors working for the United Railway Company of Portland, are running lines and getting levels for a proposed extension of the United Railway's track from Banks, in the north section of Washington county, through the Nehalem valley to this place.

SEATTLE, WASH.—Property owners living on the heights above Gatewood street in the southeastern part of the city are circulating a petition for a street railway line in Thirty-fifth avenue S. W. from Alaska street to the city limits, same to be presented to the Puget Sound Traction, Light & Power Company, and possibly to the city council.

OAKLAND, CAL.—The new Alameda-Oakland crosstown line of the Southern Pacific has been started. The

schedule was prepared and the cars tried out and inspected at the Alameda Point electric railroad shops last week. The cars are operated around the Alameda loop, thence across the marsh to Fourteenth and Franklin streets, Oakland, and on to the Sixteenth street depot.

SEATTLE, WASH.—Residents of the heights above Gatewood street, in the southwestern part of the city, are circulating petitions for a street railway line in Thirty-fifth avenue southwest, from Alaska street to the city limits. The petition will be presented to the officials of the Puget Sound Traction, Light & Power Company, and possibly to the city council.

RICHMOND, CAL.—Three street railway franchises were applied for at the last meeting of the city council. Two of the franchises were asked by the Southern Pacific. The third franchise was solicited by the San Francisco-Oakland Terminals Railway Company for permission to lay tracks in Ashland avenue. This was the franchise that was in dispute between the city and the traction company.

SANTA BARBARA, CAL.—R. H. Gaud and the Santa Barbara & Suburban Railway Company, have joined in a petition to the Railroad Commission asking that the former be allowed to transfer to the latter his street railway franchise in the city of Santa Barbara. The Santa Barbara and Suburban Railway Company also asks for a certificate of public convenience and necessity allowing it to operate under this franchise.

SAN FRANCISCO, CAL.—The Supervisors recently adopted by unanimous vote the resolution formulated by Supervisor Koshland and approved by the public utilities committee, specifying the terms upon which negotiations may be entered into with the United Railroads for the joint use of lower Market street, the first requirement being, as heretofore published, that the company cease at once all further efforts to establish its alleged rights in the courts.

VALLEJO, CAL.—Application was made recently to the Railroad Commission by the Vallejo & Northern Railroad for permission to issue $5,500,000 in bonds for the purpose of constructing an electric line between Sacramento and Vallejo, with ferry service to San Francisco. The Vallejo and Northern, while a separate corporation, will operate as an extension of the Northern Electric Railroad, connecting San Francisco with the rich territory of the Sacramento Valley.

SAN FRANCISCO, CAL.—The Board of Supervisors has directed the Board of Works to contract with the United Statet Steel Products Company for "track specials" and 110 tubular iron trolley poles for the Geary street municipal railway. The poles are to be used for the ocean beach extension of the line. For the "track specials," which include curve connections and the like, $8618 of municipal railway bond issue was ordered set aside, with $3500 for the trolley poles.

SUISUN, CAL.—The contractor for the grading of the Oakland, Antioch & Eastern Railway Company's electric railroad which it proposes to build through the eastern part of this county, has begun to assemble a large grading crew in a camp near Birds Landing, and the work will begin within a few days. The company has awarded the contract to the Union Gas Engine Company for the machinery in its new ferry boat, which will be about the size of one of the Key Route boats operating on San Francisco Bay.

TELEPHONE AND TELEGRAPH.

TEKOA, WASH.—A ten-year telephone franchise has been granted to Wm. Anderson.

SHELTON, WASH.—The Harstine Telephone Company has made application for a franchise in Mason County.

SPARKS, NEV.—The Sierra Telephone Company has asked for a franchise for a telephone system in this city.

RIALTO, CAL.—The Pacific Telephone & Telegraph Company will bid for a franchise to operate lines in this city.

EPHRATA, WASH.—The Grant Realty Company of Neppel, will extend its phone line to this place to connect with the Pacific States line.

NYSSA, ORE.—The Malheaur Home Telephone Company will do extensive reconstruction work on its lines in this town and vicinity

CONCRETE, WASH.—Stockholders of the Skagit River Telephone Company have decided to extend the telephone system to Marblemount.

RIVERSIDE, WASH.—J. H. Green, president of the Tunk Creek Telephone Company, announces that a line is to be constructed from Synarep to Anglin.

CONCRETE, WASH.—The Skagit River Telephone Company has decided to extend its line to Marblemount from Rockport, a distance of ten miles. Wm. Jennings is president of the company.

COURTLAND, ARIZ.—The various telephone subscribers of the local exchange have received notice that the local lines have been taken over by the New State Telephone & Telegraph Company, being a consolidation of the Courtland & Riggs Telephone Company and the Adams Telegraph Company.

WATERWORKS.

CHANDLER, CAL.—Dr A. J. Chandler has had plans prepared by Chief Engineer Binkley for a thoroughly up-to-date water system for the new town of Chandler. It will consist of 16-inch mains and 12, 10, 8, 6 and 4-inch laterals.

RICHMOND, CAL.—Arrangements have been completed with the People's Water Company of this city by the John Nicholl Company, whereby this company will take immediate steps in laying water mains in the new Richmond Terrace.

RIVERSIDE, CAL.—By an overwhelming vote the directors of the Riverside Water Company have decided to sell the company's domestic water plant to the city. A city election will be called at an early date to vote on issuing of $600,000 bonds for the purchase.

ELLENSBURG, WASH.—J. D. Matthews, manager of the Ellensburg Gas & Water Company, announces that he has completed arrangements for building a concrete sanitary filtering plant. Plans have also been completed for the 600,000 gallon reservoir now under construction.

PORTLAND, ORE.—Geo. Henry Jr., engineer, acting for the Pacific Power & Light Company, has placed a contract with the Mannesman Tube Works of Germany for 3600 tons of lap welt pipe, to stand working pressure of 2100 feet of water, to be tested in shop to 50 per cent above that.

SAN FRANCISCO, CAL.—A joint resolution fathered by the public utilities and water rates committees has been adopted by the Board of Supervisors, stating that it is the policy of the board to extend water service at the earliest possible date to all parts of the city now having an inadequate supply, and, if necessary, to take the money for such extensions out of the 1910 Hetch Hetchy bond issue fund. The public utilities and water rates commitees were instructed to meet at once with the city attorney, city engineer and officials of the Spring Valley Water Company to investigate the situation and to report back at the earliest possible date a plan for giving the needed relief and also to present drafts of all ordinances and resolutions necessary to carry their suggestions into effect.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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Where to Buy It in the West, Pages 9, 10.   Alphabetical Index to Advertisers, Page 8.

JOURNAL OF ELECTRICITY

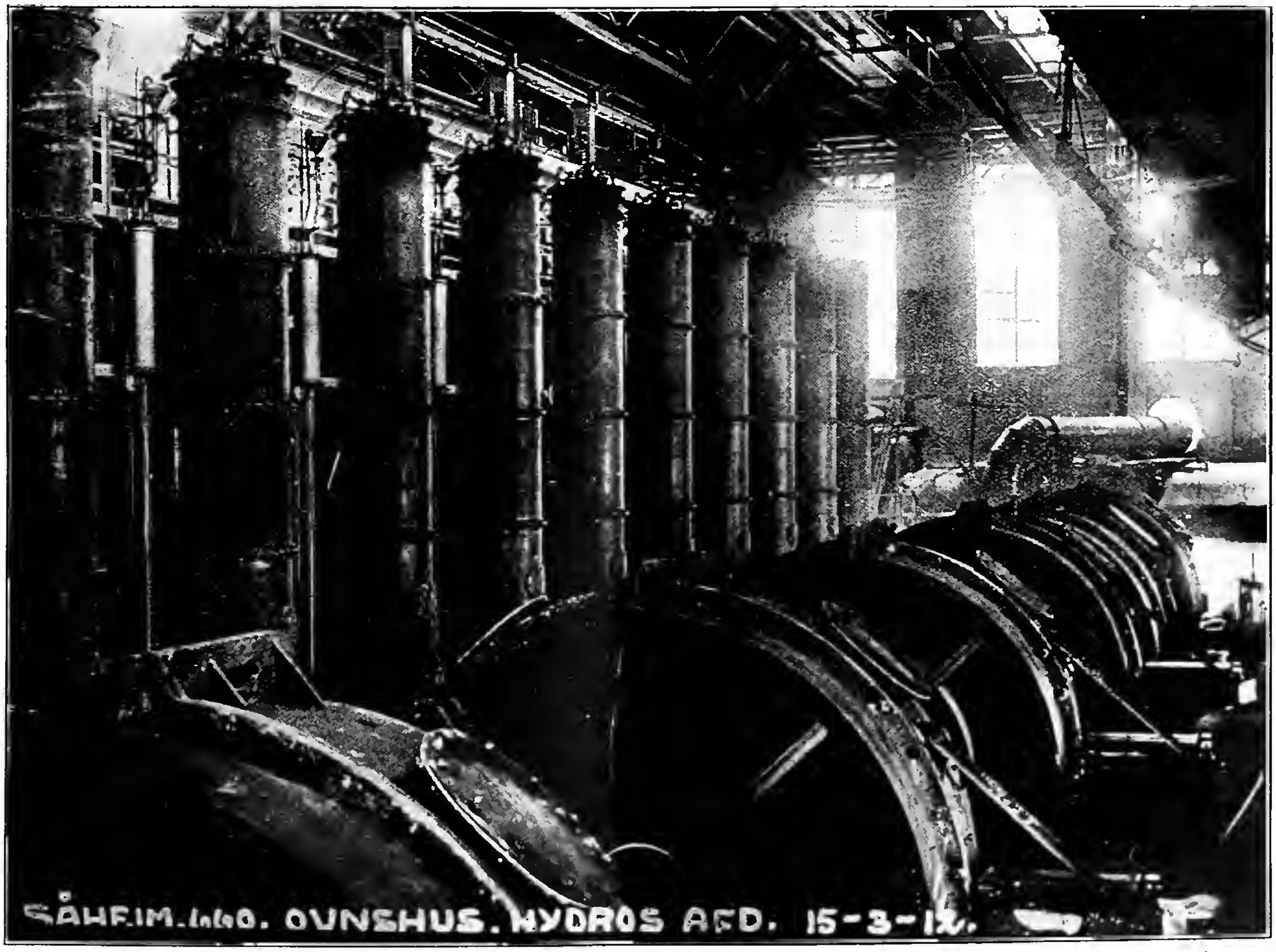
POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXIX SAN FRANCISCO, OCTOBER 19, 1912 NUMBER 16

ELECTRICAL FIXATION OF ATMOSPHERIC NITROGEN

The past fortnight has seen much flurrying in hydroelectric circles of the West due to the Western visit of Dr. Samuel Eyde, the well-known inventor of the Birkeland-Eyde processes of electrically bringing about oxidation of atmospheric nitrogen and the development of the resulting industries in Norway. During the past week Dr. Eyde has interestingly discussed his installation and process with many men on the coast engaged in hydroelectric development. The illustrations furnished herewith were personally presented to this journal by Dr. Eyde and the following description is abstracted from his New York lecture.



Giant Schoenherr and Birkeland-Eyde Furnaces at Rjukan, Utilizing Energy From the Largest Hydroelectric Plant in the World, 140,000 H.P.

chemical combinations with atmospheric nitrogen. Dr. Eyde is now in search of available cheap water power to the extent of 200,000 h.p.

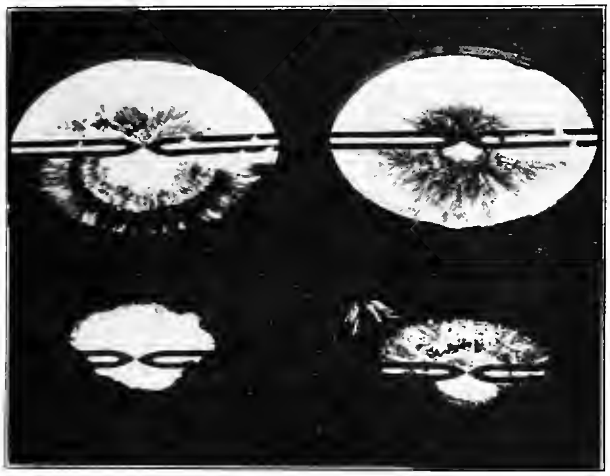
At the recent international congress of applied chemistry in New York, Dr. Eyde presented the most interesting paper of its sessions on his method of

We all know that the atmosphere surrounding us is composed of nitrogen and oxygen; to create by the

union of these two elements new chemical combinations that can be utilized in the world's household is the task of the new industry.

In order to explain the Birkeland-Eyde method, it is necessary first to describe the electric flames consisting of arcs of light, which are used in the electric furnaces.

The formation of the flame occurs by an arc of the electric flame being formed between the points of the electrodes, which are close to each other. By this means a movable and flexible current is established in a highly magnetic field. The electric arc that has been formed moves on account of this magnetic field with great velocity perpendicularly to the lines of force, and the electric arc's foot draws back from the points of the electrodes. When the length of the electric arc increases the electric resistance becomes greater and the tension increases, until it becomes so great that the new electric arc starts from the points of the electrodes.



Flame in Electric Furnace.

To regulate the current, an inductive resistance is used in series with the flame. With alternating current all the arcs are formed alternating in opposite directions and appear to the eye to be circular discs. This flame provides a powerful technical means for the oxidation of the nitrogen of the air. The flame in our furnaces burns with a steadiness that is really astonishing.

The electrodes are thick copper tubing, through which water passes for cooling purposes. The chamber in which the flame burns is circular, of only a few centimeters in width, and about three metres in diameter.

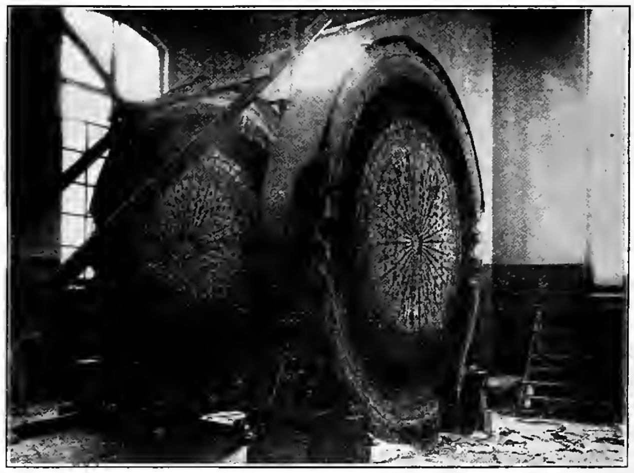
The interior of the furnaces is lined with fire clay brick, through the walls of which the air is admitted to the flame. The nitrous gases formed in the flame escape through a channel made along the casing of the furnace, which, like the flame chamber, is furnished with fireproof bricks.

In order to supply the furnace with the amount of power desired, each one is furnished with an induction coil, by means of which the power is regulated as required. The induction coil serves, moreover, to keep the flame in the furnace steady and even while working.

With this furnace we have obtained such a steady working that it burns for weeks without any regulation worth mentioning. It may further be stated that the maintenance of the furnace and its repair are simple, as the most exposed portions, the electrodes, need be changed every third or fourth week, and then only a small part of them. The fireproof masonry is changed every fourth to sixth month.

The temperature in our flames exceeds 3000 degrees centigrade. The temperature of the escaping gases may vary between 800 and 1000 degrees. The furnaces are made of cast steel and iron, the middle of the furnace being in the form of a circular flame chamber. The electrodes are led radially into this flame chamber. By aid of centrifugal fans the air is brought into each furnace through tubes from the basement. From furnaces which consumed an energy of some few horsepower, we have attained to types which can, as mentioned, take an energy of more than 5000 h.p.

We have in course of the development of our method had four experimental stations.



Interior of Electric Furnace.

Some years after the perfection of our furnace, Dr. Schoenherr, with the electrical engineer Hessberger, of the Badische Company, perfected an electric furnace for the oxidation of atmospheric nitrogen which is constructed on quite different principles. In place of the great disc of electric flame he developed a long slender arc in the axis of a narrow iron tube through which a current of air is forced.

The type now used consists of a somewhat slender vertical column of iron plates 7 metres in height. The inner tube is the reaction chamber, the others form channels for the entrance of the air current and its exit after coming in contact with the flame. In this way the heat of the outgoing gas is transferred to the ingoing current.

At the lower end is the main electrode which is movable in a vertical direction, as it must be raised from time to time when the end is worn away by the arc.

The reaction tube serves as the second electrode. By means of a lever the space between the electrode and tube can be bridged over and the arc formed.

The air current forced by a powerful aspirator enters in the lower part of the furnace and passes the channels. The entry into the reaction chamber is through a number of small tangential openings ar-

ranged in several horizontal rows in the sides. The current passes in this way around the chamber and the arc is driven up in the midst of the rapidly moving current of air.

As a rapid cooling is of importance in securing a good yield, the upper third of the tube has a water jacket through which the gases pass, and in this way the reverse reaction is prevented to a notable degree.

The reaction is identical with that obtained in the Birkeland-Eyde furnace, and the yield, as far as the results now obtained is practically the same.

I will describe the process and give you some details of the various parts of the factory.

The air for the furnaces is procured by swiftly revolving ventilators, and is conducted through large iron pipe lines to the furnaces.

At Notodden we have only furnaces of the Birkeland-Eyde system, from 1000 to 3000 kw. capacity. At Rjukan there are, however, furnaces of the Birkeland-Eyde system of 3000 kw. as well as furnaces of the Schoenherr system, all of 1000 kw.

When the air in the flame chamber has been acted upon by the electric flame the nitrous gases formed pass out through pipes, which convey the gas to the steam boilers, in which the temperature, which was 1000 degrees C., is reduced.

The steam produced in the boilers is utlized in the further treatment of the products. In the boiler house there are also air compressors, which supply compressed air for pumping acid and lye in the various chemical departments.

The gases pass on from the steam boilers through an iron pipe into the cooling house, and complete the cooling begun in the steam boilers.

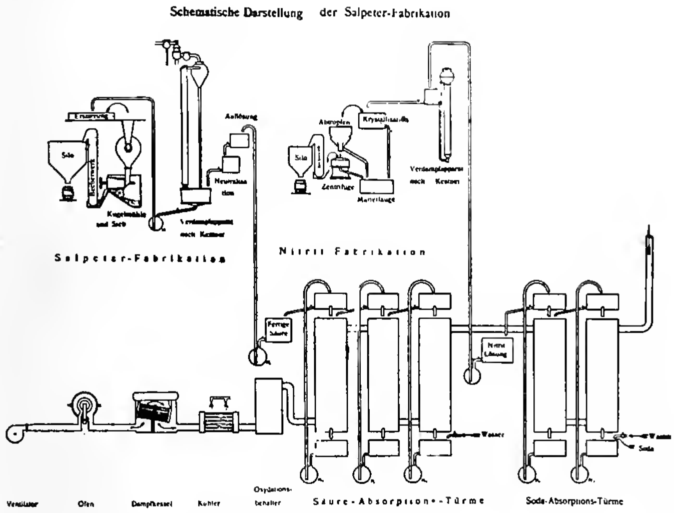
Each cooler consists of a great number of aluminum tubes, over which cold water runs, while the hot gases pass through them. The temperature of the gas is considerably reduced. From the cooling chambers the gases pass to the oxidation tanks.

These oxidation tanks are vertical iron cylinders, lined with acid proof stone. The object is to give the cooled gases a sufficient period of repose, in which time the oxidation of the nitrogen oxide may occur. The necessary amount of oxygen is present in ample quantity in the air which accompanies the gases from the furnaces. From the oxidation tanks the gases by blast engines are led into the absorption towers.

The towers are filled with broken quartz, which is neither affected by nitrous gases nor by nitric acid. To assist the passage of the gases on their way from the furnaces there are centrifugal aluminum fans on each row of towers.

The gases enter at the base of the first tower, go up through the quartz packing and thence by a large earthenware pipe enter the top of another tower, through which they pass downwards through the quartz to the bottom of the third tower, and so on, until the air, relieved of all nitrous gases, leaves the last tower. Water trickles through the granite towers, and this is gradually converted into a weak nitric acid, while the liquid used in the iron towers is a solution of soda. The absorbing liquid enters the top of the tower and is distributed in jets by a series of earthenware pipes, so that the permeating gases enter into immediate contact with the absorbing liquid. Nitric acid is thus formed in the granite towers and in the iron towers a solution of nitrate of soda.

The liquid emerges in a constant even stream from the bottom of the towers, running into a granite cistern. It then flows in to the montejus which serve to pump up the acid, which has to pass repeatedly through the tower before it has become strong enough for the purpose for which it is intended. The montejus are worked by compressed air and send the acid up into large stoneware tanks. From these jars the acid again runs through the towers. The montejus work automatically.



The Cycle of The Birkeland-Eyde Process.

The iron towers are percolated, as already mentioned, by a solution of soda, otherwise the whole process is practically similar to that in the granite towers. The solution of soda owing to its far greater power of absorption, effects the separation of the last remaining traces of nitrogenous gases from the accompanying air. Of the entire quantity of nitrous gases passed through the absorption system, about 97 per cent is absorbed. The finished nitric acid coming from the towers, which has a strength of about 30 per cent by volume, is collected in granite cisterns, from which it is drawn to what is called the "dissolution works." These consist of granite vats filled with limestone, over which the acid is poured. This drives off, with violent effervescence, the carbonic acid of the limestone. The nitric acid takes its place and forms a watery solution of nitrate of lime or calcium nitrate. The rest of the acid is neutralized in small towers filled with milk of lime and is now pumped into vacuum evaporating apparatus. A great saving in heat is effected by boiling in vacuum.

The steam required for the evaporation is obtained from the steam boilers, heated, as before mentioned, by the furnace gases. The concentration of the nitrate solution in the evaporizing plant is continued until the specific weight of the liquid at an even temperature shows a content of 13 per cent nitrogen. This solution is then sufficiently evaporated, and can be pumped up into the solidification chambers, where it is conducted upon a revolving cylinder, cooled on the inside. It then stiffens so rapidly that it will easily spring off into small leaf-like pieces, which can

be granulated without difficulty in the crushing mill. There the mass is reduced to a granular state.

The coarse powder produced is raised by an elevator to a vat, from the bottom of which it is dumped into casks holding 100 kilos net weight.

The gas lead into the iron tower forms with the solution of caustic soda, a solution of nearly pure sodium nitrite. This is concentrated by evaporation in the same sort of apparatus as above and allowed to crystalize. The crystals are dried in a centrifuge and put up in casks.

The barrels are made at our own cooper's shop and are lined with paper to guard against damp.

In addition to these two products, nitrate of lime and nitrite of soda, we have during the last years at our Notodden works taken up the manufacture of concentrated nitric acid and nitrate of ammonia, which products have already established themselves and are shipped in comparatively large quantities to the United States and other countries.

We are, however, not confined to the products mentioned. There are possibilities for the development of a series of new industries, as the nitric acid—our first product—is the basis of the manufacture of a great many products used in the industries and in agriculture.

Visitors to our factories are often under the impression that the works are not running at all. There is but little noise and workmen are hardly visible. It is remarkable indeed how few people are required to run the establishments. As a matter of fact comparatively large working forces are only needed in the packing and wrapping departments.

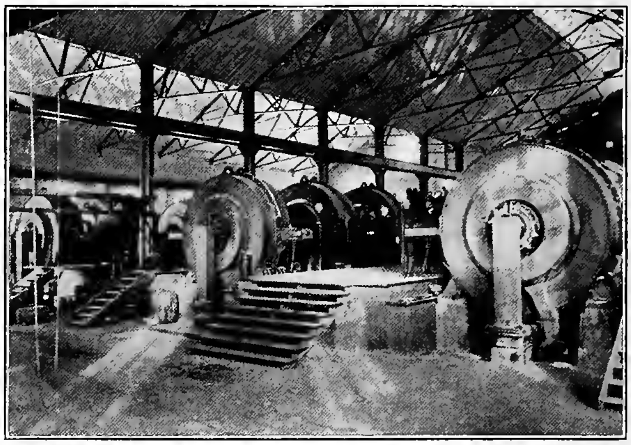
For the development of the atmospheric nitrogen industry the question of water power is a vital one. Hence the Norwegians have given this question as much attention as the chemical part of the manufacture. Our industry cannot exist unless it can procure cheap water power. But there is hardly a country in the entire world that can boast of more favorable conditions in this respect than Norway, and the enormous rise of our industry must be attributed to a very large extent to Norway's magnificent opportunities in the amount of water power available for manufacturing purposes. It must be borne in mind that Norway has not only her magnificent and high waterfalls but that she has large mountain lakes, permitting the construction of enormous natural reservoirs for conveying the water to the power stations. In our districts we enjoy the most favorable conditions in this respect. The works now built are all situated in the southeastern part of Norway, in the Telemark river district.

The most important works, the Notodden nitrate factories, are admirably situated on the lake of Hiterdal, about 50 ft. above the level. A short channel with a series of locks, permits communication with the town of Skien, an important seaport at the head of the fjord. Under present conditions vessels of 200 tons burden can ascend to Notodden. It is planned to enlarge the locks so as to allow the passage of seagoing vessels of 2000 tons. The ability to ship directly to all parts of the world by water, with one transhipment, is an important factor in the future of the Notodden nitrate industry.

The Notodden factories, which now use about 60,000 h.p., secure their power from two neighboring waterfalls, Lienfos and Svaelgfos. At Lienfos, about two miles from Notodden, a dam with a fall of about 55 ft. was completed in 1911. The volume of water is 75 cubic metres per second. The power station is equipped with four units, of 5000 h.p. each. The Svaelgfos power house is situated above and about one mile from Lienfos. The volume of water is the same as at Lienfos. The dam has, however, a fall of about 165 ft. A tunnel takes the water to the reservoir, from which four flumes cut into the solid rock conduct the water to the station, where there are four sets of turbine generators of 10,000 h.p. each.

The generators are capable of producing 13,000 h.p. and rank among the largest units in the world.

The power of these two waterfalls is transmitted to Notodden by six separate transmission lines. Each line consists of six cables, 12 millimeters in diameter. The three-phase alternating current of 50 periods is transmitted with a voltage of 10,000.



Mammoth Electric Furnaces at Notodden, Norway.

A second power station at Svaelgfos is now under construction. As the normal volume of water by an additional regulation of distant lakes in the same watershed will soon increase to 90,000,000 cbm., in the new power station, two units of each 10,000 h.p. will be built.

About 16 miles further up the river the first regulating dam at the Lake of Tinn was constructed at the same time as the water station of Svaelgfos and the factories at Notodden. The immense basin created by this dam makes it possible to store up fully 300,000,000 cubic metres of water.

For transportation purposes to and from the Rjukan factories it has been necessary to build two railways, one of 19 miles, from Notodden up to the lower end of the Lake of Tinn, and one of ten miles, from the lake up to the factories at Saaheim. Ferryboats and large barges provide transportation on the lake between the terminals of the railways.

The railroad from the lake up the narrow valley to Saaheim passes just beneath the large mountain Gausta; a few miles further up Saaheim and the factories are situated.

The transmission line is built on heavy iron masts, About two and one-half miles from the factory up in the valley lies the power station, a large building of granite, about 120 metres long. The Rjukan waterfall

Lienfos Power Station, Developing 20,000 H.P.

lies one mile further up in the valley. It is not only this waterfall itself, but the total fall in the river of a distance of about six miles which is to be harnessed up.

It is planned to have two power stations. The first, now in operation, lies at Vemork, on a ledge of the cliff, 1000 ft. below the terminal reservoir of the tunnel. The water is conducted from the reservoir down the mountain side to the turbines in ten huge flumes, side by side. These flumes are five feet in diameter. The upper sections are of riveted steel plates; the lower, where the pressure reaches 30 atmospheres, are made of welded plate, one inch in thickness. They rest upon a foundation built upon the solid granite of the mountain.

The water descends 971 ft. to the Vemork turbines. Immediately upon leaving the power station the water enters another tunnel, excavated in the side of the cliff, and is conveyed to a point slightly more than three miles down the valley where a similar series of flumes for the second power house is now under construction. The total fall here is 909 ft.

When in full operation the two power stations will furnish the factories with 250,000 h.p., perhaps 270,000 h.p.

In the Vemork power house are ten units of 14,000 h.p. Pelton wheels are used in the turbines on account of the great pressure of the water. They have a maximum capacity of 17,500 h.p. A three-phase alternating current of 50 periods is transmitted from this power house to the nitrate works through 60 wires, partly of copper, but chiefly of aluminum. The working voltage is 10,000.

The reservoir on the top of the flumes is blasted out of solid rock from the intake, where a dam is built across the river. For the regulation of the water supply a dam has been built at Lake Mosvand by means of which the level of the lake is raised over 46 ft. As the surface of the lake is not less than 23 square miles, nearly 900,000,000 cubic metres can be retained. The minimum flow in the river is in this way increased from 5 to 47 cubic metres per second, or the water power at Rjukan only, from 30,000 to 250,000 h.p.

To give you an idea of the development of our industry I review the factories we have had at the different times:

Svaelgfos Power Station, Developing 40,000 H.P.

Dates.	Factories.	No. H.P. Utilized.	Employees.	Workmen.
July, 1903	Frognerkilens Febrik	25	2	2
Oct., 1903	Ankerlokken	150	4	10
Sept, 1904	Vasmoen and Arendal....	1,000	6	20
May, 1905	Notodden	2,500	4	35
May, 1907	Notodden and Svaelgfos ..	42,500	12	403
Nov., 1911	Notodden, Svaelgfos, Lienfos and Rjukan I	200,000	143	1,340

If you ask me what above all has contributed to such a rapid development of our industry, then I wish to mention the confidence the financial people gave me and the excellent collaboration between my engineers and myself. We are all working to create something great and useful for our country, and we all had in view the great importance this new industry would have from an international point of view.

THE RELATION OF THE HORSEPOWER TO THE KILOWATT.

There was, before 1911, no precise definition of the horsepower that was generally accepted and authoritative, and different equivalents of this unit in watts are given by various reference books. It is obviously desirable that the horsepower represent the same rate of work at all places. The value most used in electrical practice has been the round number, 746 watts, and in 1911 the American Institute of Electrical Engineers adopted this as the exact value of the horsepower. Thus defined, it is the rate of work expressed by 550 foot-pounds per second at 50 degrees latitude and sea level, approximately the location of London, where the original experiments were made by James Watt to determine its value. The number of foot-pounds per second in a horsepower accordingly varies with the latitude and altitude. This value, 746 watts, will be used in future publications by this Bureau as the exact equivalent of the "English and American horsepower." The horsepower tables in this Bureau's Tables of Equivalents formerly assumed 550 foot-pounds per second as the correct equivalent at 45 degrees latitude, because of the well-established use of 45 degrees as a standard latitude. This gave the inconvenient relation, 1 horsepower = 745.6494 watts.

The "continental horsepower," which is used on the Continent of Europe, is similarly most conveniently defined as 736 watts, equivalent to 75 kilogram-meters per second at latitude 52° 30′, or Berlin.

THE DESIGN OF A REINFORCED CONCRETE FLUME.

BY B. A. ETCHEVERRY.

A reinforced concrete flume which has been installed in the Northwest and which has proved thoroughly satisfactory is described in the following notes:

The accompanying drawing gives the rectangular flume section to be used wherever necessary on the main canal between the heads of pipe lines F and G, as dimensioned in the table below. The flume sections for the remainder of the canal will be similar, varying only in size. The dimensions of flume sections for the different parts of the main canal and for the elevations shown are tabulated below.

Dimensions of Concrete Flume Section for Main Canal.

Section of main canal.	Required carrying capacity in cubic feet per second.	Inside bottom width in feet.	Inside total depth in feet.	Depth of water in feet.	Carrying capacity with freeboard of 6 in.	Elevation of water surface. At upper end.	Elevation of water surface. At lower end.
F-G	28.00	4.00	2.25	1.75	28	1158.00	1153.00
G-I	15.65	4.00	2.00	1.50	15.65	1140.50	1137.50
I-J	11.30	3.50	2.00	1.50	11.30	1137.50	1136.75
J-K	8.19	3.00	2.00	1.50	9.0	1137.50	1136.00
K-L	4.56	2.00	2.00	1.50	6.0	1136.00	1135.00

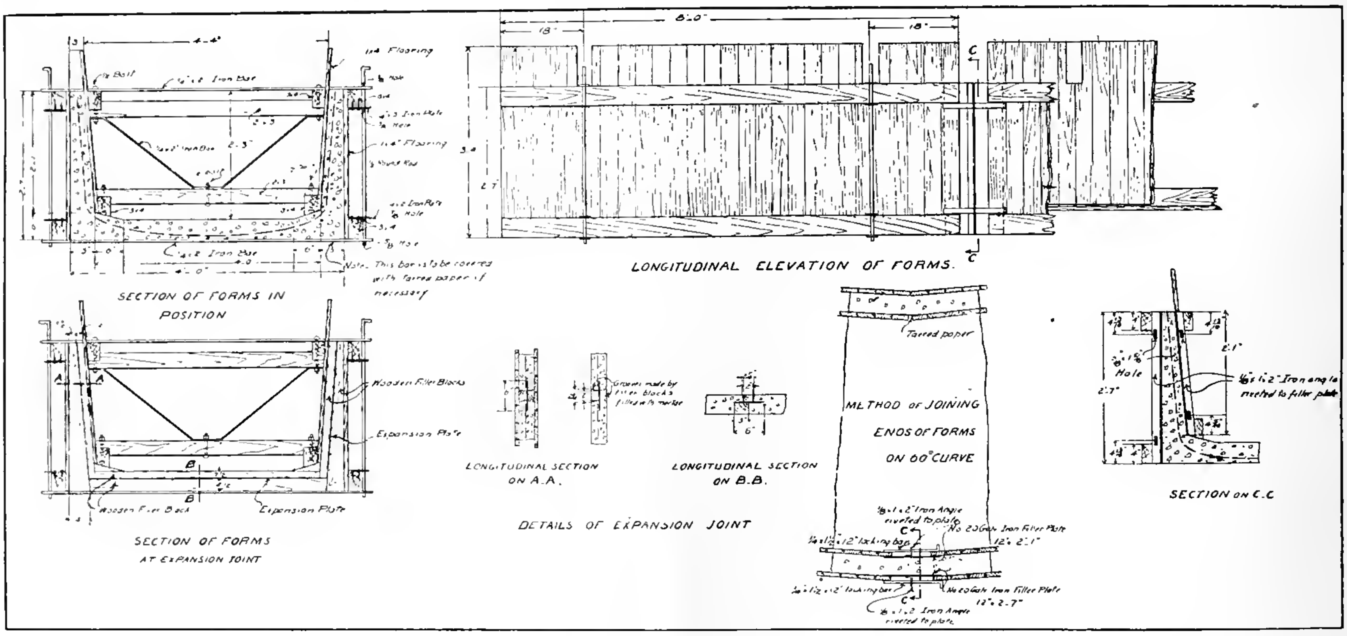
It may be feasible to use the trapezoidal section for most, if not all, of the main canal. Where feasible the trapezoidal section should be used.

Flume Supported on Two Piers.

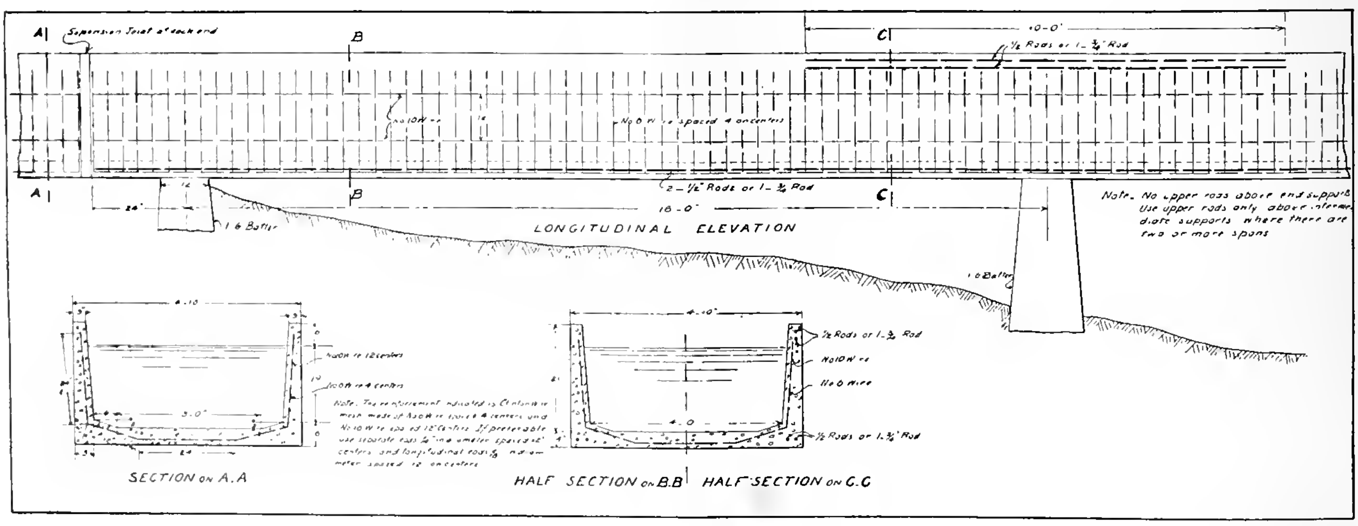
The drawing shows a longitudinal elevation of the flume supported on two piers, the span between being 18 ft. This form of construction can be used to advantage to cross a short depression where it will be more economical to do this than to go around it by means of sharp curves, or to construct a flume on filled ground and be safe against settlement. Usually the flume will be supported on a bench cut in the side hill and will have the cross section shown in the drawing as cross section A-A.

Concrete Flume Constructed on Bench.

This flume consists of the side walls 3 in. thick at the top and 5 in. thick at the bottom and a floor 4 in. thick. The reinforcement shown is Clinton wire mesh made of No. 6 wire 4 in. apart and No. 10 wire 12 in. apart. This reinforcement will cost probably 2¼ or 2½ cents a square foot and may be purchased in rolls, the maximum width of the rolls being 108 in. For



Concrete Forms for Canal.



Main Canal as Concrete Flume.

our purpose, in order to provide an expansion joint every 16 ft., rolls 8 ft. wide would be best. The rolls will be cut in lengths of 9 ft. and bent to conform with the drawing and placed across the flume between the forms. The sheets should overlap along the edges to make the reinforcement continuous longitudinally. With this reinforcement the thickness of the walls and floor could be decreased by 1 in., but I believe that it would be difficult to construct thinner walls. If the walls and floor are constructed at the same time, so as to form a monolithic structure, I believe no reinforcement is necessary, for the tension on the concrete without the reinforcement is only 15 lb. per square inch. But unless it is found that the reinforcement increases the difficulty of construction very seriously, I would prefer to use it. A lighter reinforcement could be used, and if Clinton wire mesh can not be obtained, some other form of fence wire mesh could be substituted for it.

Flume Supported on Piers or Resting at the Two Ends on Solid Rock.

This form of construction differs from that of the flume supported on the bench in that there is additional longitudinal reinforcement to make the side walls act as girders or beams across the span. In this case all the reinforcement shown must be used, for the floor is held by the side walls and acts as a floor slab and must necessarily be reinforced. The girder reinforcement when there is one span only will consist of the two lower ½ rods. When there is more than one span, intermediate piers will be necessary and above each pier in the top of the side walls two ½ rods are required to resist the negative bending moment. The two lower rods of the side wall must either be sufficiently long to reach over the entire span or may be built of pieces, the end overlapping not less than 24 in.

The piers must extend down to solid rock or, if built on ordinary firm soil, must be supported on a concrete footing bed 3 ft. by 5 ft. and 1 ft. thick. The top of the piers must be well oiled or preferably covered with a piece of tarred paper before constructing the flume, in order to prevent adhesion with the under side of the floor and permit expansion and contraction without producing stress on the pier. Expansion joints at each of the two end supports will be sufficient.

The flume will be constructed with the same forms and in the same manner as the flume supported on the ground surface, except that some provision must be made to construct the floor slab and support the forms and the flume across the span during construction. This may be done in two ways: first, by using a wooden floor between the piers and level with their tops, supported on stringers and post; second, by building a fill between the piers and level with their top. The first method is best where the height of the floor above the ground surface is large; it will not be as expensive as might seem, for the same wooden form and stringers could be used for all heights, varying only the height of the posts. The second method is best where the height is not large. Where the flume is built on filled ground the piers extending down to solid foundation and the longitudinal reinforcement are necessary to prevent any damage due to settlement.

Design of Forms.

This design is for a concrete flume on a main canal where the flume is 2 ft. 3 in. deep and 4 ft. wide on the inside. The same design will apply, however, to the other sections of the main canal by modifying the dimensions of depth and width. The forms are 8 ft. long and consist of an inside trough and two outside walls. The side walls of the inside trough are made of flooring nailed vertically to the 3 in. x 4 in. longitudinal pieces. The top of the walls extend 9 in. above the top of the outside forms to facilitate the placing of the concrete. The two side walls of the inside troughs are bolted to spacing frames which are made of two horizontal, 2 in. x 3 in. pieces, connected to a diagonal bracing made of ¼ in. x 2 in. bent iron bar. These spacing frames are placed 5 ft. apart, 18 in. from each end of the form. The connection is made with bolts in

Concrete Flume in Construction.

order that the same side walls could be used for flumes of smaller width but of the same height by varying the spacing frames only. At each spacing frame a horizontal iron bar, ¼ in. thick by 2 in. wide and about 6 ft. long, is bolted to the spacing frame and the top longitudinal piece of the side wall. The purpose of this bar is to support the inside form on the outside form walls and to hold the outside walls and inside form in their proper position. The inside form is not collapsible and I believe it is not necessary that it should be, for the side walls have an inside batter of 2 in. in the depth of 2 ft. 3 in. and are made of smooth flooring placed vertically to decrease the friction. By keeping the forms well oiled there should be no difficulty in lifting the forms after the concrete has hardened. If there is a large length of concrete flume I would recommend lining the inside form with thin galvanized iron.

The outside form walls are also made of vertical flooring nailed at the top and bottom to 3 in. x 4 in. longitudinal pieces. Each outside form wall is held at the correct distance from the inside wall by a ½ round rod which passes vertically through a ⅝ in. hole made

in the top horizontal bar at each spacing frame, and through corresponding holes made in plates screwed to each longitudinal piece of the outside wall and into a hole made at one end of another horizontal bar placed on the under side of the floor, on the ground surface. This bar could be eliminated where the character of the material will permit the driving into the material of the vertical round rod or of bracing pegs. This lower horizontal bar is taken out after the removal of the forms, and to prevent the adhesion of the concrete to it, it should be well oiled or preferably covered with a strip of tarred paper. The floor will be made level and given the proper thickness by using a straight edge of the form indicated below, which will rest on the two lower longitudinal pieces of the inside form.

Expansion Joint.

The expansion joint shall be spaced 16 ft. apart and will be formed by placing in the forms a 6 in. strip of No. 16 galvanized iron between tapered wooden filler blocks, as shown in the drawing. The flume is built continuously and the plates with the filler blocks are placed 16 ft. apart. The filler block under the plate in the floor slab is removed before the construction of the next floor section, but this can follow very soon afterwards, for even if the two sections run together at the joint, it will be a weak place, especially if the edge of the filler block was well oiled. The other filler block will be taken out after the removal of the forms. The grooves formed by the filler block will then be filled with a rich, stiff mortar which will complete the joint. To obtain a good expansion joint all the contact surfaces except that between the mortar and the metal plate must be well oiled to prevent strong adhesion. The ends of the plate projecting into the concrete walls should be well oiled to permit contraction, the ends of the plate acting as a tongue. The contact surfaces between the mortar and the concrete should be well oiled to give a weak bond. To obtain a good bond between the mortar and the metal plate, it would be desirable to take a hatchet or pick or other sharp instrument and perforate the metal surface which is exposed in the groove after the removal of the filler blocks.

Method of Joining End of Forms on a Curve.

When constructing the flume on a curve the ends of the forms will not butt up close together. To fill the space between the ends of the walls of the forms when this is only a narrow crack, a piece of tarred paper will do, but for a wider space a filler plate as shown in the drawing is to be used. The filler plate is made of thin galvanized iron, is 12 in. wide, 2 ft. 7 in. long for the outside wall and 2 ft. 1 in. long for the inside wall. On the center of the plate and longitudinally a 1/8 in. x 1 in. x 2 in. iron angle is riveted to it. In the long leg of this angle rectangular holes 3/8 in. x 1 5/8 in. are made for the insertion of locking bars, which not only hold the filler plate in position but also hold the adjacent ends of the forms at the same level.

THE SOCIETY FOR ELECTRICAL DEVELOPMENT.

As the direct result of the co-operative meeting held at Association Island, Henderson Harbor, N. Y., September 3, 1912, "The Society of Electrical Development" has been formally organized at a meeting of the Organization Committee. The next meeting will be held in the Engineering Societies Building, in New York City, on October 18th.

The above information is perhaps of even greater importance than it appears in cold type, for the forming of the new society really means the getting together of the four branches of the business, central station, manufacturer, jobber and contractor, in an endeavor to develop co-operatively the business as a whole so that each interest will be benefitted. The plans will include a central bureau for the carrying on of the work, which will be along the lines of advertising and publicity for the education of the publice to the greater uses of electricity for light, heat and power and mutual education along advertising and selling lines in an endeavor also to improve the present distributing channels and in every way develop the most efficient methods for advancing the interests of the business.

COMMUNICATION ON SEATTLE LIGHTING RATES.

To the Editor: In the September 14th issue of the Journal of Electricity, Power and Gas there is an article by J. D. Ross on the light and power rates of the Seattle municipal plant. The writer states that when the city plant first began to operate in 1904 the competing company had a rate of 20c per kilowatt hour, and that this rate was later reduced to 12½c per kilowatt hour, based on the connected load.

I want to make a correction, particularly so, as Mr. Ross, superintendent of the Seattle municipal plant, has repeatedly misstated in publications issued by himself the rates charged by the competing company, and which company is the company that I have been connected with since 1899. The rate was only 20c per kilowatt hour for the first 30 hours burning of the maximum demand, after which the rate dropped to 5c per kilowatt hour, with a discount of 10 per cent. Likewise, this company never had a rate of 12½c—the rate was 12c for the first 60 hours burning of the maximum demand and 3c for all excess, with a discount of 10 per cent.

I have upon two different occasions called the attention of Mr. Ross to the error he has made in citing the rates formerly charged by this company, but he persists in continuing to misstate the rates, and I would be pleased if you can have your readers' attention called to these errors.

W. J. GRAMBS.

[In connection with the above communication Mr. Grambs submits correspondence from the city council requesting the Puget Sound Traction, Light & Power Company to bid on the street lighting and a copy of their bid to the city. This bid is on the basis of one cent per kw.-hour delivered to the municipal substation, or a rate of 2¾ cents per kw.-hour if the company operate and maintain the street lamps and street lighting system as at present operated and maintained by the city; further provision being made for rental of municipal poles. This bid was referred to the city utilities committee at the last meeting of the city council. The municipal authorities have recently increased the charges for street lighting from 4 to 4½ cents.—Editor.]

READINESS TO SERVE METHODS.[1]

BY ROSS B. MATEER.

Readiness to serve methods, had their origin with Henry and Doherty, now a prominent feature in the financial, managing and operating of central stations.

As early as 1902, Mr. Doherty analyzed the costs of central station operation as consisting of three factors and based the charge for service upon them in his effort to arrive at a fair and equitable rate for current as a commodity.

First, a yearly demand charge regulated and fixed according to the hourly maximum demand of appliances, or lamps connected, which charge takes care of all fixed expenses of a company such as occasioned by the installation of the proper distribution systems, interest on investment, taxes, depreciation, etc.

Second, a fixed consumer charge to cover such expenses as are occasioned by investment in, installation, maintenance, removing and reading meters, billing, collecting, office work, free work, etc.

Third, a charge for current representing the consumption, which governs all items varying in proportion to consumption, such as fuel, boiler room expenses, labor, renewals, repairs, etc.

From the above rate the term Readiness to Serve was evolved covering as it does all items that enter into the generation and distribution of current, provided for the central station consumer.

Arriving at a satisfactory basis of charge, for the commodity, the next step naturally was the commercializing of the central station. Instead of waiting behind a counter for a request for service, a corps of engineers and salesmen, was recruited and after a series of meetings, the plan formulated upon which rests all of the development in business-getting game.

In a 1902 convention of the National Electric Light Association, Mr. Doherty stated: "Our earnings through economy of operation have well-defined limits, but the possibilities of increasing our earnings by developing our market have a much wider range. I believe our business today might be considered as of a retail nature compared with what it will be a few years hence."

In 1907 he refers to light as synonymous with optimism. Artificial light attracts everything animate, from bugs to men and that for every dollar expended in brilliant illumination at least ten dollars of benefit will be secured to the city where the display is made.

He further stated: "Each day the commercial end of our business assumes greater and greater importance. The aggressive work being done by many central stations in the country has created a new standard of lighting, and while it is possible for the other central stations to do nothing and still reap some benefit from the works of others, it is now possible for a small expenditure of money and effort to bring splendid returns in the field of development of business."

You will note that in 1902 the merchandizing of the central station and modern methods were proposed. In 1905 by the introduction of a commercial program in the N. E. L. A. it was in effect and operation in several so called Doherty properties. Those who attended the June convention at Seattle were astounded to learn that operation was second place and that methods of increasing load factor by specialization attracted the attention of nearly everyone present.

The merchandizing of the central station proposed, rapid strides were made in the development of the business getting organization, special development such as Industrial Power, Electric Display and Advertising, Domestic and Appliance were soon created which found its own field of labor very broad, and results obtained in many central stations today are only the result of the time and energy displayed and the apostle of commercialism and those assisting him that we might have a perfect medium of doing business between the public and the corporation.

Mr. Doherty's methods might be summarized in stating that it is his rule to meet the public more than half way. In all matters affecting the interest of both the corporation and the public and that no branch of custom is too small to receive the attention of the management. As a result of this policy the term "complaint" is eliminated and those calling at the office by reason of high bills or service trouble usually leave an order and do not register a "kick."

The education of employes was inaugurated; lectures and talks were given regularly to the new business force, to the accounting department and to the operating branches on subjects of general interest. Special talks were given to the commercial department on the best way of securing business and its profitableness to the central station to secure competent men for positions in operation and management. College graduates were invited to enroll in this school of gas and electric practice. A complete course of instruction by means of lectures and by experience in all branches of central stations, developed men so that they were capable to put in force standard systems of active, modern and aggressive business getting. Efficient schemes of operation which have resulted in greatly increased earnings and which was used to acquire other properties.

It is well to bear in mind that many stations have not awakened from their lethargy and are doing nothing to hurry along the growth of their business; then, there are others who have made or are making spasmodic and irregular efforts along the new business line. Some electric lighting companies are alive to their practice and go in for the business of every character in every commodity increasing the net earnings and receiving the co-operation of the public and eliminating tendencies towards municipal control and arbitrary rulings.

[1]Read before San Francisco Development Electrical League, Oct. 8, 1912.

EXPORTS ON PORTLAND CEMENT.

Before the manufacture of Portland cement was undertaken to any great extent in the United States this country was a heavy importer of that commodity. Now, however, we are sending more cement beyond our borders than was ever imported. The largest importation of cement in one year was in 1895, when 2,997,395 barrels were brought in. For the eleven months ending in May, 1912, we exported 3,053,539 barrels. Importations promise to increase from now on.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS FOR RAPID TRANSIT TUNNEL AT SAN FRANCISCO.

Bion J. Arnold, under date of October 7, 1912, submitted preliminary report No. 8 which supplements preliminary report No. 5 and deals with the Market street extension. This extension contemplates a rapid transit tunnel under Twin Peaks Ridge. The summary of Mr. Arnold's conclusions and recommendations is as follows:

First: Concerning Project A, main or hill section, later studies have confirmed my previous recommendation in preliminary report No. 5, that if it is determined to build at present only the main portion of the tunnel between the southwest portal and Eureka street, the northeast end of the tunnel should be built with the object of connecting at sub-grade with a future Market street subway, and not connecting directly with the surface grade. An inclined entrance would then become necessary at Eureka street which could be ultimately abandoned, or utilized for routing trolley cars to the surface at this point.

Second: Whether the tunnel is extended down Market street at the present time or not, I am convinced that the contour extension of Market street should be carried out at once while the property is relatively inexpensive.

Third: This contemplates also the construction of the contour Boulevard around Twin Peaks, as advocated by the various Improvement Associations. This low-grade extension of Market street will form the much needed traffic thoroughfare down the Peninsula, supplementing the rapid transit tunnel.

Fourth: Concerning the second section of Project A, this should be built as a two-track subway from West Mission street to Castro street along the north side of Market street at high-level; that is, with station platforms as close to the street surface as the structural design will permit. In this manner, a future parallel bore will be provided for at minimum cost, to be built at sub-level (that is, at a depth sufficient for an overhead concourse). Thence it will proceed directly through the hill at low-grade from Castro street to the southern portal.

Fifth: Acquire sufficient easement width when the first project is carried through to accommodate both present and future bores, as well as stations. The additional cost at the present time for both bores will probably be but little more than for the first.

Sixth: Considering the limitations imposed by the necessity for reasonably rapid operation through the tunnel, not more than three stations between the north and south portal appear to be desirable for the present:

"Church street," located in the valley at Fourteenth and Church streets; side platform, sidewalk entrance.

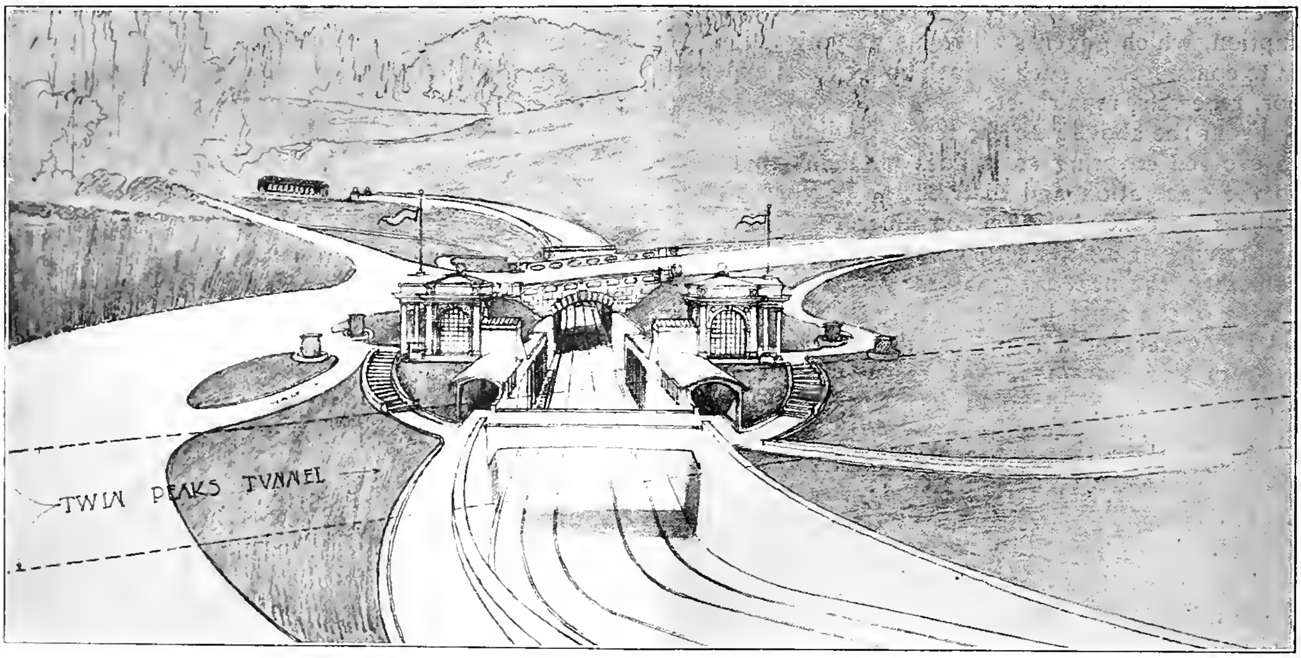
"Eureka Valley," located along Market street contour extension, between Collingwood and Eureka street; island platform, central entrance kiosk.

"Laguna Honda," located on city property at the intersection of Seventh avenue and Dewey Boulevard; side platform, escalator or ramp entrance.

One future station, "Noe street," has been provided for by raising the tunnel grade to the proper level; but this should be built for local stops, and only when the development of cross-town traffic warrants.

Seventh: Both Market street stations, at Church street and Eureka valley, should be built at high-level. Church street may be developed later into a sub-level express station later described, with the necessary direct transfer facilities between express and local platforms.

Eureka valley station may be expanded into a reservoir station as soon as traffic warrants, so as to provide "passing tracks" for through service or in conjunction with the branch-off tracks of the proposed Mission-Sunset tunnel connecting at Eureka street. This will be independent of the future low-grade bore



Perspective View of Development of Laguna Honda Transit Center.

of Project B, which will pass beneath Eureka Valley staiton, either on the same alignment or a more direct one.

Eighth: Laguna Honda station should be constructed at the highest level consistent with the maximum grade established—3 per cent—but at sufficient depth to permit a future overhead crossing beneath the surface of Dewey Boulevard for trolley cars of connecting transfer lines, this super-grade crossing to be developed as soon as traffic conditions warrant, but independent of the present tunnel station.

Laguna Honda station has been located largely on city property, and an unusual opportunity exists for effective utilization and enhancement in value of the entire city tract. The improvement of this locality and the boulevards leading thereto should therefore be undertaken by the city at its earliest opportunity. An open cut crossing for trolley cars will save much of the expense of a covered sub-grade station such as shown herein.

Ninth: The upper Market street subway section should be designed so as to connect directly at subway grade with a future four-track section extending down lower Market street. All subway branch-off lines should be designed without grade crossings. Present designs must fit into a proper scheme of future development without necessitating expensive reconstruction, particularly with reference to station structures.

Tenth: The lower Market street subway section, which will become necessary in the future, should be built with a standard four-track section, with all four tracks built at sub-level, permitting an overhead concourse from sidewalk to sidewalk beneath the street from which access may be had to both express and local platforms, with direct transfer between them. This section is well adapted for connection with the upper Market street section of Project A, as herein recommended. It is idle to consider a two-track section, because of the number of branches that will probably be required.

Eleventh: In the location of stations, provision should be made for ultimately extending the platform to accommodate the longest multiple-unit train contemplated. For the present, both high-speed interurban and trolley suburban cars will be operated through the tunnel. This dissimilarity in equipment makes it desirable for these two types to berth at separate platforms; consequently, stations not less than 350 feet in length should be provided for at present, accommodating three-car interurban trains and three trolley car units. On account of this length of platform, and the serious loss in speed due to additional stops, stations should not be built closer than 1500 or 2000 ft.

Twelfth: An inclined exit at Castro street will be required, so long as both local and express trains are operated through the hill tunnel, to relieve the Market street subway section of such locals as do not require a through run. The incline utilizes otherwise waste space west of Castro street in order to obviate an obstruction in upper Market street.

Thirteenth: Enlargement of the present two-track project to four tracks must come when the safe minimum headway has been reached, under conditions of minimum safety factor as determined by rigidly applied rules for the style of equipment and the type of signal system installed.

Fourteenth: The relative volume or headway of express and local traffic that can be accommodated effectively within the one bore should be largely determined by the necessities of express service. This is the principal object of the rapid transit project.

Fifteenth: Before traffic necessitates a second or express bore, it is likely that local suburban service can best be handled in the present bore by special subway equipment running between the city and the county line, with adequate transfer facilities en route to numerous trolley feeder lines. And as a lower Market street subway will probably also be required by this time, it will then become desirable to exclude all but standard subway equipment from the rapid transit system.

Sixteenth: When the ultimate Market street subway project is completed from the Ferry to Eureka Valley, a Market street local or transfer route will become desirable. For this purpose provision has been made at Castro street for subway locals to loop around in Eureka Valley close enough to Eighteenth street to warrant a loop terminal station for originating or transfer traffic in addition to the main Eureka Valley station herein provided for.

Seventeenth: Branch subways will unquestionably become necessary in the future, to feed the main Market street artery. These branches will be discussed in more detail later, but the development of the city seems to indicate the following as most desirable:

(1) South, or Mission branch;
(2) West, or Park-Richmond branch;
(3) Southwest, or Park-Sunset branch.

All run beneath the surface until out of the heavily settled districts.

Eighteenth: Grade separation will ultimately become necessary below the southwest portal. The present right of way contemplated along Junipero Boulevard can only be regarded as a makeshift, and ultimately the rapid transit line should be diverted one block east by open cut or sunken roadway. It is extremely important that subdivision of residential properties should be carried out with this in mind.

Nineteenth: Ventilation and automatic block signal plants will become more and more necessary as traffic through the tunnel increases. Provision for the former should be made in the original design, and some form of block signal will be required from the start, to be later perfected and amplified in order to handle effectively the denser traffic.

Twentieth: The McCoppin street portal may be retained after the upper and lower Market street bores have been connected, as a most convenient means of access to a terminal property which will presumably be located in that vicinity, at least for interurban trains. But the exact position of this portal will be dependent considerably upon the location of this terminal property.

ELECTRICAL NOTES FROM ARGENTINE.

The hydroelectric development of the Iguazu Falls consists of erecting a hydroelectric plant at the falls and conveying the electric energy sixteen miles to a site where the factory would be erected.

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POWER AND GAS

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895
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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The Impatient Board

Something over a year ago the city council of Los Angeles employed a board of experts to advise as to reasonable rates for electrical energies in that municipality. After an exhaustive investigation, this board made a remarkably just and comprehensive report, covering the points under investigation. In face of this report and its highly scientific methods of arriving at rate charges, the city council arbitrarily threw the entire advice aside and made an entirely new schedule, by rule of the thumb which has resulted in unscientific and unjust proportioning of electrical charges in that municipality.

Today the city of San Francisco is employing a noted expert at a costly figure to investigate the traffic situation within its confines. Thus far, information of the greatest importance to San Francisco's future growth has been gathered. The daily press of that city, however, recently detail the impatience of several members of the Board of Supervisors in awaiting the final report and it is even hinted that action may be taken on certain important matters without having at hand the mature conclusions of the traffic expert. Enquire among the critics of the recommendations that have been made thus far and their overwhelming comment is that after all the traffic expert has advised not anything really technical as was supposed would be forthcoming from such a skilled engineer, but on the other hand advice has been given such as would be dictated by anyone possessing commonsense.

In answer to this criticism all should remember that "there is one thing about common sense—it isn't common."

New Fields of Endeavor

At a recent meeting of the San Francisco Electrical Development League, W. W. Briggs forcefully brought out his convictions that a large part of our energies are expended in endeavoring to take from each other business already created rather than looking afield and seeking where activities may be better expended in the development of new applications.

Much interesting discussion concerning a new industrial application for electrical energy has taken place during the past ten days between Western power men and Dr. Samuel Eyde, the eminent inventor from Norway, an account of whose wonderful accomplishments may be found on another page of this issue. Here is a possible application for electrical energies bringing to life countless new industries and yet a decade has not passed since the initial bow of the Birkeland-Eyde process of electrically bringing about synthetic nitrogen products. This industry had its birth in a commonplace and yet, in some respects, a unique manner. About ten years ago Dr. Eyde met Professor Birkeland, a fellow countryman, at a ban-

quet in Norway. During the course of the evening Professor Birkeland, noting a far distant look in Dr. Eyde's countenance, asked what he was thinking about. Dr. Eyde replied he was thinking that if some one would give him a stroke of lightning to play with he could perfect a great invention. Professor Birkelund forthwith explained some wonderful experiments on electrical arcs he had been putting through. The next morning a patent was taken out. In 1903 the employment of two men saw the incipiency of a new industry. Today in Norway 200,000 electrical horsepower grind out eternally some 100,000 tons per annum of valuable synthetic nitrogen products. Not only does this installation contain the largest single hydroelectric power plant in the world—that at Rjukan, developing 140,000 h.p.—but power is generated, including depreciation operation and 6 per cent interest on invested capital, at the remarkable figure of $3.30 per h.p. per annum.

The West may well take a lesson from the industry and creative imagination of these Norwegian scientists and inventors. Nature has distributed water power throughout that section of America with a lavish hand. With these gigantic water powers as a stimulus, an opportunity is offered, not to develop powers to saturate a field already amply covered with electrical supply, but an opportunity is offered for the engineer of the future who possess initiative and can invent new uses and new industrial processes. Because of such initiative, not alone will the electrical fraternity reap the harvest but awaiting the engineer himself is a just and bountiful reward.

The Passing of the Wooden Flume

Hydroelectric development has indeed been rapid. In the last issue of this journal, J. D. Galloway set forth in a forceful manner the technical features encountered in hydroelectric design, the evolution of which has made possible such progress in this art. Beginning with crude methods of "cut and try," handed down from the days of forty-nine, and the hydraulic giant, the majestic impulse water wheel of today has developed into the delicately regulated mechanism, which is so well-known to all familiar with the make-up of the modern high head hydroelectric plant.

It is questionable, however, if even this remarkable evolution has not been outclassed by the forward advance in flume and canal design. The picturesque wooden flume, clinging tenaciously to the sheer cliff for its only protection from certain and complete destruction, recalls in memory strenuous days of a former generation, but the neatly lined tunnel of today, piercing this sheer cliff presents visions of construction for more in accord with modern installation. Indeed, the almost complete abandonment of the wooden flume in favor of steel and concrete applications is one of the most noticeable features of modern canal design.

In irrigation, too, the use of concrete is today wholly used in the more permanent work. In Southern California, because of the high value of water, cement and concrete for irrigation design were put into use earlier than in any other region in the United States. Moreover the San Joaquin valley of California, the Modesto and Turlock irrigation districts, are today using concrete for most of their new structures and, in fact, former wooden installation is rapidly being replaced. The great Northwest, also is arising to a full appreciation of the permanent and durable characteristics possessed by this modern evolution in canal design. On another page of this issue will, in fact be found a detailed description of the installation of a reinforced concrete canal, which has recently been installed in British Columbia and which today is found thoroughly satisfactory in its operation.

Hydraulic cement was known to the ancients. It was, as history records, used in Egypt sixteen hundred years before the Christian era. Over two thousands years ago, the Romans built sewers, water mains, and buildings, with a natural cement. The remains of some of these structures, as seen today, are monuments to the durability and permanence of this material.

This material, which may be purchased in the market today, is of different kinds and properties. Portland cement, for instance, is made of certain definite ingredients put together in just the proper proportions necessary for the theoretical chemical combination of the elements involved. These ingredients, consist approximately of three parts of lime carbonate to one part of silica, alumina, and iron oxide, which are burned to semi-fusion and the resulting clinker is then finely pulverized. Natural cement, on the other hand, is the product obtained by calcining natural clayey limestone rock at a proper heat. This product is likewise pulverized for use. Finally a third product is that known as modern puzzolan or slag cement, which is made by mixing in proper proportions a granulated blast furnace slag with slaked lime. As in the former instances, the mixture is then ground to a fine powder for application in the arts.

Each of these different types of concrete have their fields of usefulness in the up-building of Western hydroelectric enterprises. A series of articles dealing with this subject is now being prepared by a well-known coast expert and will appear in the columns of the Journal at an early date.

In conclusion, as we review in mind the passing of the wooden flume and its other associates brought into existence by a demand for early delivery of water at the lowest prices possible, we must realize that we have now entered a new order of things. In a word, the question of cost now becomes secondary in consideration while stability and permanence in structure with maximum efficiency in operation must be the watchword for the future.

PERSONALS.

H. B. Duncan, secretary of the San Bernardino Valley Gas Company, is at San Francisco.

Allen G. Jones, sales engineer with the General Electric Company's San Francisco office, is at Chicago.

J. B. Lukes, the representative of the Stone & Webster Construction Company, has returned to San Francisco after visiting Reno, Nev.

W. A. Brackenridge, vice-president of the Southern California Edison Company of Los Angeles, is at San Francisco with Mrs. Brackenridge.

H. G. McMillan, salesman for the mining department of the Fort Wayne Electric Works, is making an extensive tour of the Pacific Northwest.

R. B. Elder, Pacific Coast representative of the Moloney Electric Company, and the Ideal Electric & Manufacturing Company, is at Salt Lake City.

D. C. Greene, manager for the Oregon Power Company, at Marshfield, Oregon, has been elected president of the Marshfield Chamber of Commerce.

A. Oudin, a director of the General Electric Company, residing at Buffalo, sailed on the steamer Korea from San Francisco this week on a tour of the Orient.

A. G. Minehart Jr., representing The R. Thomas & Sons Company, is visiting the trade on the Pacific Coast. He is now in the Northwest, having just completed his rounds in California.

F. E. Vickers, Pacific Coast inspector of steam turbines for the General Electric Company, has returned to San Francisco from a visit to the works at Schenectady and other points of interest.

Dr. Thomas Addison, Pacific Coast manager of the General Electric Company, returned to his headquarters at San Francisco during the week after having visited Schenectady N. Y., and the Eastern States.

C. R. Weymouth, chief engineer of Chas. C. Moore & Company, has an interesting and comprehensive paper in the current proceedings of the A. S. M. E. on the dimensions of boiler chimneys for crude oil.

S. K. Colby, vice-president of Pierson, Roeding & Co., has returned to San Francisco from Chicago, where he attended the annual convention of the National Street Railway Association and had a royal good time.

Stone & Webster interests in the far Northwest are well represented at the Chicago Electric Railway Convention by A. B. Campbell, George Carson and E. C. Gaummitz of Seattle; G. W. Rounds of Tacoma and K. K. Carrick of Everett.

J. McA. Duncan has been appointed district manager of the Westinghouse Electric & Manufacturing Company for Pittsburgh district, in place of **W. F. Fowler**, who has resigned to accept a position with the W. S. Kuhn comporation.

H. O'Mara, superintendent for the Oregon Power Company at Marshfield, Oregon, has been elected president of the local association of company employees, and **D. McIntire**, auditor for the company, has been elected secretary.

A. E. Wishon, assistant general superintendent of the San Joaquin Light and Power Corporation, and **L. M. Peart**, electrical engineer with the company, were at San Francisco this week to appear before the State Railroad Commission.

Dr. Charles Terzaghi, an engineer representing the Austrian government, in the course of a tour of the world to inspect irrigation systems, power plant facilities and various kinds of government projects, is now in Washington and Oregon.

Herbert E. Smith, city sales manager for the Safety Insulated Wire & Cable Company at San Francisco, has returned from a six weeks' trip East, during which time he perfected arrangements to bring the future Mrs. Smith to California early in 1913.

E. Berg, an engineer of Christiania, Norway, who is acting as foreign representative for the synthetic nitrogen chemical works in which Dr. Samuel Eyde is interested, has arrived at San Francisco after having investigated the hydroelectric plants of the Pacific Northwest.

S. R. Inch, manager of the Missoula Street Railway Company of Missoula, Montana, delivered a most interesting paper at the recent Chicago convention. The paper gave details of the system so effectually in use in Missoula wherein but one man is necessary to operate the P-A-Y-E cars there employed.

A. W. Bullard, vice-president and general manager of the Great Western Power Company, expects to leave for an extentive Eastern trip early next week. He will spend some time at Schenectady, going over the plans for the high duty 3-phase generators to be manufactured by the General Electric Company for use in the extension of the Las Plumas hydroelectric station.

W. E. Barrett, general manager of the Midway Gas Company, and **H. M. Dougherty**, superintendent of construction for J. G. White on the Midway gas pipe line contract, are expected to arrive at San Francisco by the end of the week for a consultation. The 12-inch pipe extending to Los Angeles is now filled with natural gas and successful tests have been made.

Dr. Frank A. Wolf of Washington, D. C., who is the professor of physics and electrical engineering of the Bureau of Standards, Weights and Measures, is a recent San Francisco visitor. He has contributed much towards a proper development of improved apparatus, and methods of measurement, and has also engaged in research on the standard of electromotive force.

W. W. Briggs, assistant general sales manager of the Westinghouse Electric and Manufacturing Company; **A. V. Thompson, J. O. Case** and **Samuel A. Chase,** have been authorized by the Panama-Pacific International Exposition management to present to the Annual Rejuvenation of the Jovians at Pittsburg an invitation to hold the Rejuvenation of 1915 at San Francisco during the Exposition. An especially engraved invitation was forwarded to them with credentials.

OBITUARY.

Frank E. Blanchfield, until recently sales manager of the Pacific Coast department of the American Ever Ready Company, died at Oakland, Cal., October 7, 1912, after a prolonged illness. He was born at Pittsbugh, Pa., in 1885, having been on the Pacific Coast since 1905. The untimely termination of his promising career is a matter of deep regret to the host of friends who had learned to respect his high character.

FRANK E. WATTS ELECTED JUPITER AT TENTH CONVENTION SONS OF JOVE.

PITTSBURGH, PA., Oct. 17, 1912.—The tenth annual convention of the Rejuvenated Sons of Jove has come to a successful conclusion. Frank E. Watts, sales manager for the Sunbeam Incandescent Lamp Company, has been elected eleventh reigning Jupiter. The rejuvenation on Tuesday night was the finest ever. The new constitution and by-laws was adopted. The attendance at the convention was close to 750 and the meetings most spirited.

MEETING NOTICES.

San Francisco Jovian Lunch Club.

The regular weekly meeting of the Jovian Lunch Club of San Francisco was held at Tait's Cafe, October 15th. B. Badrian presented an interesting paper on Ozone. In outlining a plan for providing entertainment the governing board announced the appointment of a committee, each of whose members would provide the entertainment for one weekly meeting and in rotating as follows: Chairman, A. H. Halloran; Manufactures, A. V. Thompson; Supply Dealers, M. L. Thompson; Contractors, C. F. Butte; Central Stations, M. E. Wise; Technical, G. L. Bayley.

Portland Engineering and Architectural Societies.

The regular weekly luncheon of the Engineering and Architectural Societies was held at the Hotel Portland, October 8th. H. R. Wakeman, chairman of the Portland Section of the American Institute of Electrical Engineers, presided. Frank B. Riley, state vice-president of the Pacific Highway Association, spoke on the subject of better roads. At the meeting of October 15th, over which E. F. Lawrence presided, G. B. Hegardt, engineer of the Dock Commission, spoke on the Dock Commission's Building Ordinance Controlling the Water Front.

Portland Jovian Lunch Club.

The Jovian Lunch Club of Portland met at the Hazelwood on October 3rd to hear a talk by F. J. Lonergan, attorney, on the subject of the Referendum Petition which will come before the voters of Oregon at the special election to be held on November 2. 1912. Mr. Lonergan gave some very excellent reasons why competition in public utilites is uneconomical and cited well-known authorities who have investigated the matter of competition in lighting utilities. At the meeting on October 10th Ellis F. Lawrence outlined the plans whereby Portland's traffic is to be handled effectively and the city made more attractive. He also reported on similar work in other cities. Geo. R. Sailor is Statesman at Portland.

Electrical League of Southern California.

At the regular luncheon of the Electrical League of Southern California on October 8th, S. M. Kennedy, general agent with the Southern California Edison Company, presented an interesting paper on "The Progressive Spirit."

MEETING SAN FRANCISCO SECTION A. I. E. E.

The next meeting of the San Francisco Section of the American Institute of Electrical Engineers will be held at 8 p. m., October 25, 1912, in the Pacific Telephone & Telegraph Company's Building at New Montgomery and Jesse streets. A paper on "Modern Improvements in Electric Street Lighting Units" by C. R. Wallis will be presented. The paper will be illustrated by lantern slides. An informal table d'hote dinner will be served at Jules' cafe at 6:15, before the meeting, to which all members are invited.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

October 4.

The Railroad Commission rendered a decision granting authority to the Central California Gas Company to issue $219,000 of additional bonds and $136,200 of additional preferred stock. Proceeds from the sale of the securities will be used for construction purposes and to purchase the Consolidated Heat, Light & Power Company, of Visalia and Tulare.

October 7.

The Commission rendered a decision granting the Great Western Power Company a certificate of public convenience and necessity to operate in Suisun, Fairfield and Dixon.

The Pacific Gas & Electric Company was granted permission to construct a spur track at grade across a public highway, near Towle.

The West Coast Gas, Light & Fuel Company and the Home Gas & Electric Company, of Newport Beach, applied for authority to consolidate under the name of the West Coast Gas Company, and to extend operations into the towns of Downey, Norwalk, Artesia, Somerset and Clearwater. It was also proposed that the consolidated corporation issue $250,000 of bonds.

J. H. Evans applied for a certificate of public convenience to operate a telephone system in and about Patterson, Stanislaus County.

October 9.

An amendment was made to an order granting the Oro Electric Company permission to serve certain territory in San Joaquin County outside of the city of Stockton. The Western States Gas & Electric Company, now operating in Stockton, was given permission to serve certain parts just outside the city limits.

October 10.

The Commission granted an order permitting the Pacific Light & Power Company to purchase the distributing system of the Glendale Light & Power Company for $5,200.

The Marconi Wireless Telegraph Company of America applied for permission to install a night letter service between Avalon, Catalina Island, and San Pedro, on the mainland.

EXTRACT FROM REPORT OF PROGRESS.

International Electrotechnical Commission and International Electrical Congress in San Francisco, 1915.

BY H. A. LARDNER.[1]

[1]Vice-President on Pacific Coast Relation.

The Panama-Pacific International Exposition Company has definitely assigned us a meeting room, to accommodate 100 members, and two committee rooms, for the week beginning September 6, 1915, for the use of the International Electrotechnical Commission; also an auditorium, seating about 1000, with ten committee rooms, each to seat from 100 to 250 persons, for the week beginning Monday, September 13, 1915; and they have further definitely set aside the auditorium for 1000 people, asked for, for the International Electrical Congress for the following specific hours:

Forenoon of Monday,	September 13, 1915
Afternoon of Wednesday,	September 15, 1915
Evening of Thursday,	September 16, 1915
Afternoon of Saturday,	September 18, 1915

and the ten committee rooms have been reserved for meetings to be held afternoons and evenings for the entire six days of the week.

We have the further assurance of the Exposition authorities that they have reserved the above designated accommodations for us in an auditorium to be erected in the Civic Center, at some point near the corner of Van Ness avenue and Market street. This latter location has been the subject of some discussion, but it has been decided by the Committee on Organization that they would, for various reasons, prefer this location to an auditorium located within the Exposition grounds; in fact, they have made quite a point of this, and it is with great pleasure that we can announce that we have definitely secured this assignment.

It would appear that we have now definitely settled with the Exposition authorities concerning all of the important matters which are urgent at the present time. We have official advices from the Exposition authorities that our Congress has made more definite progress than any Congress which has been proposed for 1915; and up to a very recent date we were the only Congress to whom definite dates and space for meetings had been assigned.

The American Institute of Electrical Engineers also proposes to participate in and support the International Engineering Congress, but has not seen its way clear, in view of the International Electrical Congress, to take the lead in the matter.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

WIRING REQUIREMENTS AT PORTLAND.

(Concluded)

Overhead District.

(A) System.

The company operates the following system of electrical distribution from which current is supplied for light, heat and power:

(a) For Lighting, Heating and Small Motors:

A three-wire single-phase, 60-cycle alternating current system of voltage 117 and 234, approximately.

(b) For Power:

A three-conductor three-phase, 60-cycle alternating current system of voltage 234, approximately.

(c) For the Operating of High Speed Elevators and Special Apparatus Requiring Variable Speed Motors—The Company also Furnishes in Certain Districts:

A two-wire direct current system of 600 volts, approximately.

The company must be consulted before installations are made of 600 volt apparatus, as such installations will not be connected outside of certain districts, limits of which will be given upon application to the commercial department. Application for 600-volt direct current service must be made in writing, and the agreement on the part of the company to furnish such service must be obtained in writing, as no verbal agreements made by any of the company's employes will be considered binding upon the company.

(B) Wiring.

(See general requirements, Division 1, Sections A, B, and C.)

(a) All service feed wires must extend at least two (2) feet outside of all buildings and must be installed in conduit from a point ten (10) inches beyond outside wall to the meter board. Where exit light or passenger elevator circuits are to be taken off ahead of the main service switch, as called for by sections 723½ and 788 of the Building Code of the City of Portland, the branch cut-outs for same must be installed in an approved steel cabinet having a blank metal cover which can be sealed by the company. Where pull boxes are necessary, approved outlets with blank metal covers may be used.

(b) Service feed wires must be brought to outside of building at a location convenient to the lines of the company.

(c) Where it is desired to have the service feed enter the basement, the wires must be installed in a suitable conduit to a height of at least fifteen (15) feet up the side of the building or up one of company's poles.

(d) Where it is desired to install service up a pole, the company must first be consulted.

(e) Suitable return bend, goose neck or some approved outlet must be provided at top of conduit as a protection against rain where same is installed up the side of a building or up a pole.

(f) In the case of Flats, Apartments or Stores, all meters must be grouped together in one room accessible to the company's employes, with one set of service outlets for lighting, and one set of service outlets for power. Should it be necessary to group the meters in any other manner, written application must be made to the company and approval received before doing any work.

(g) In all Flats, Apartments or Stores, requiring more than one meter on lighting service, a special switch cabinet with a separate switch for each Flat, Apartment or Store, must be installed in such a manner that it can be sealed by the company, and not interfere with the cut-outs.

(h) The company will install a recording watt-hour meter upon all services, and the necessary wiring must be provided by the customer in all cases.

(i) Diagrams for wiring of meter loops for the various kinds of services were given on page 328 of the Journal, and the wiring for meters must be installed as shown in diagram.

(j) Two-wire meters will be installed on all 220-volt single-phase motors, and the service and meter loops for all such installations must be 2-wire, except in the event that lighting is taken from the same service.

(k) Meters should always be located as near as possible to the point where the service enters the building, or as near as possible to, and on customer's side of the main line switch and cut-out.

(l) The meter location must not be over seven (7) feet above the floor, nor less than two (2) feet above the floor, and the location should be dry, free from vibration, easy of access for reading and inspection, and where possible in a well-lighted place.

(m) Loops for power meters must be wired in a location that will be free from vibration when the motor is running.

(n) Cabinets installed for meters must be of a size sufficient to give clearance of at least six inches on all sides of the meter.

(o) In large installations (requiring meters of 100 amperes' capacity and over) the company should be consulted before making provision for meters, as in such cases current transformers will be installed, and provision must be made for their installation in connection with the meters.

(p) The neutral tap for the three-wire meters must in all cases be soldered to the neutral wire, and not merely fastened by a binding screw of switch or cut-out.

(q) Insulated supports for meters must be provided in all cases of installation in metal cabinets. Meter boards for this purpose will be furnished by the company upon application.

(C) Motors.

(a) Motors of less than one horsepower must be 110 to 120 volt, 60-cycle, single-phase, alternating current, except as provided in (d).

(b) Motors of one horsepower and up to two horsepower (not including two horsepower) must be 220-240 volt, 60-cycle, single-phase, alternating current, except as provided in paragraphs (d) and (e).

(c) Motors of two horsepower or over must be 220-240 volt, 60 cycle, three-phase, alternating current except as provided in paragraph (e).

(d) Where there is a two horsepower or larger 220-volt, 60-cycle, three-phase motor installed, all other motors may be of the same rating.

(e) All motors of two horsepower or less used for dumb-waiter elevator service must be 60-cycle, single-phase and of the repulsion induction type or equivalent.

(f) Where the total connected load is less than two horse power, the motor or motors may be connected to the lighting meter. If the load is two horsepower or over the wiring must be arranged for a separate meter for the motors, except in the case of motors for dumb waiter service in hotels and apartment houses.

(g) Upon all alternating current motors larger than five horsepower, special devices must be provided for reducing the current at starting.

PORTLAND ELECTRICAL CONTRACTORS' ASSOCIATION NOTES.

The regular bi-monthly meeting of the Association was held at the Bowers Hotel Tuesday evening, October 8th, there being a full attendance to welcome the representatives of the local electrical jobbing houses who had been invited as special guests.

After the excellent dinner had been served, all present adjourned to one of the private parlors where the business meeting was held. By special arrangement C. W. Abbott, sales engineer for the National Metal Molding Company, appeared before the meeting with samples of the new and much improved line his factory is now putting out. His demonstration was decidedly interesting and those present were a unit in voting the new metal molding a decided improvement over the old line.

The association has adopted the plan of having factory representatives appear before the body from time to time and demonstrate any new lines that may be of interest to the contractors. It is believed that this is a very practical idea for it gives the salesman an opportunity to speak to the contractors collectively, thus saving the time of going to each contractor's establishment. By presenting the matter in this manner, after business hours, more deliberate thought can be given to the subject presented for the petty affairs that require one's attention during the busy hours of the day have been laid aside and besides there is the benefit to be derived from the general discussion.

Following Mr. Abbott's discussion, matters of vital importance that affect the trade from both the jobbers' and contractors' interest, were freely discussed with the jobbers present until a late hour and it is hoped and believed that much good will ensue as a result of the meeting. A committee was appointed to confer with a committee from the jobbers with the object of carrying negotiations further.

The association voted to engage the services of Mr. Edwin G. Amme, on salary, as permanent secretary who would be in position to attend to the many duties connected with that office. Mr. Green, the retiring secretary, has done valiant work, all of which is greatly appreciated by the members, but the many new plans in contemplation will require so much work that no member could afford to take the necessary time from his business to properly attend to them. This innovation will probably result in a material increase in membership.

ANNUAL CONVENTION OF OREGON ELECTRICAL CONTRACTORS' ASSOCIATION.

The executive committee of the Oregon Electrical Contractors' Association is arranging plans for a two days' session at Portland at the time of the annual meeting, December 10th. Efforts will be made to prepare a program that will be full of interest and entertainment for the State members and friends so that they will feel well repaid for their viist. Details of the program will be furnished later.

ELECTRICAL CONTRACTORS' NOTES.

Engineer M. Couchot, French Bank Building, has completed the plans for the new building which is to be erected for the Department of Electricity at Alameda and which will house their lighting system and fire alarm system. The structure will be a reinforced concrete building with two frame buildings in connection. A large amount of machinery will be installed. Bids for the work are now being taken and will be opened on October 16th. Plans and specifications are in the hands of the Alameda Department of Electricity and contractors can secure the same from the Secretary of the Department at Alameda.

TRADE NOTES.

NePage-McKinney & Co. of Seattle have been awarded the contract to furnish power, light and telephone equipment for the new ten-story Multnomah Security Company building, at Portland. McNaughton & Raymond are the architects.

The Westinghouse Machine Company, East Pittsburg, reports an order from the San Diego Electric Railway Company, San Diego, Cal., for one 5000 k.v.a., 3 phase, 60 cycle, 2400 volt turbo generator set with 50 kw. direct-connected 125-volt exciter.

The Pacific Gas and Electric Company has awarded the Allis-Chalmers Company a contract for twelve 4250 k.v.a. and nine 4000 k.v.a. transformers for use on 125,000 volt circuits in connection with the new hydroelectric plants under construction on Bear River.

The John R. Cole Company of San Francisco has decided that hereafter it will not carry San Francisco stocks of the eastern factories which it represents. The company's present warehouse on Folsom street will be closed and offices will be opened in some central building, where orders will be taken for factory shipment.

The General Electric Company is finding a brisk demand for the new electric motor for oil-well service, which has just been put out. It is a motor of the Hunt type, with two speeds, and has a remarkably high-power factor on both speeds. It develops 20 h.p. on the high speed and 10 h.p, on the low speed and is said to be quite an improvement over other motors that have been in use in the California oil fields during the past year.

The American Ever Ready Company's factory at San Francisco is extremely busy on account of the increasing demand for tungsten flashlight batteries and the big Christmas treė outfit trade. A large portion of the miniature lamps and tree lighting outfits for the Pacific Coast will be made at San Francisco this season. On an average, 200 barrels of the American Ever Ready Company's batteries, etc., are being shipped daily. Big editions of two new small catalogues have just been issued.

It has been announced by The Old Mission Portland Cement Company that their mill at San Juan, San Benito County, California (formerly the San Juan Portland Cement Company) is to be completed and put into operation in the near future. The firm of Smith, Emery & Company, industrial engineers, at San Francisco and Los Angeles, have been engaged to design and erect the mill. It is expected that the output of this mill will be a factor in the market next spring.

NEW CATALOGUES.

The Crocker-Wheeler Company have issued a neat and attractive booklet concerning Ampere, N. J., in general, and their own organization at that town in particular. The booklet is a beautiful example of offset printing.

The Electric Storage Battery Company have issued an attractive booklet regarding some of the purposes for which storage batteries are adapted, giving interesting facts about them and showing how widely the batteries of this company's manufacture are used.

For the convenience of their patrons, the General Electric Company will issue, at intervals, supplements to its general supply catalogue No. 4824, showing new devices brought out since the publication of the main catalogue. Supplement No. 2 is now being distributed by the company.

The Ohio Brass Company have issued a handsome descriptive catalogue on the Tomlinson Car Coupler Equipment for electric railway service. These include the automatic radial, the automatic air connecting and the M. C. B. automatic types, as well as spring drawbar carriers, draft gears and accessories.

INDUSTRIAL

DETAILS OF OLYMPIC POWER COMPANY'S NEW INSTALLATION.

The Westinghouse Electric & Manufacturing Company, through their Seattle office have obtained an order from the Olympic Power Company, Port Angeles. Wash., for the Bremerton, Wash., extension of the transmission system, involving apparatus for the new substation at Bremerton, to serve the commercial load of the Bremerton-Charleston Light & Fuel Company and for the Navy Yard load of the Puget Sound Naval Station. The apparatus for the Bremerton substation consists of three 500 k.v.a., O. I. S. C., 66,000 volt delta connected primary, 2300 volt delta connected secondary, lowering transformers complete with Burke type, pole-top fused switches and type "GA" automatic series trip oil circuit breaker with one 2 panel switchboard with necessary integrating and graphic recording instruments.

At Porta Gamble and Port Ludlow, Wash., where they cross Hood's Canal by means of a sub-marine cable, there are two substations, one known as North Hood's Canal substation and the other as the South Hood's Canal substation. At the North Station there will be installed the following apparatus of the outdoor type: One 3-pole, single throw, fused type Burke pole-top disconnecting switch, one automatic series trip type "GA" 66,000 volt circuit breaker, three 500 k.v.a., O. I. S. C. delta-connected, 66,000 volts, high tension, 13,800 volts, and 6600 volt low tension transformers, one switchboard panel with necessary integrating and graphic recording wattmeters. The crossing will be made at a potential of 13,200 volts and it is proposed to run local lines from both the North and South substations at a potential of 6600 volts for reaching that load which can be served within an economical radius.

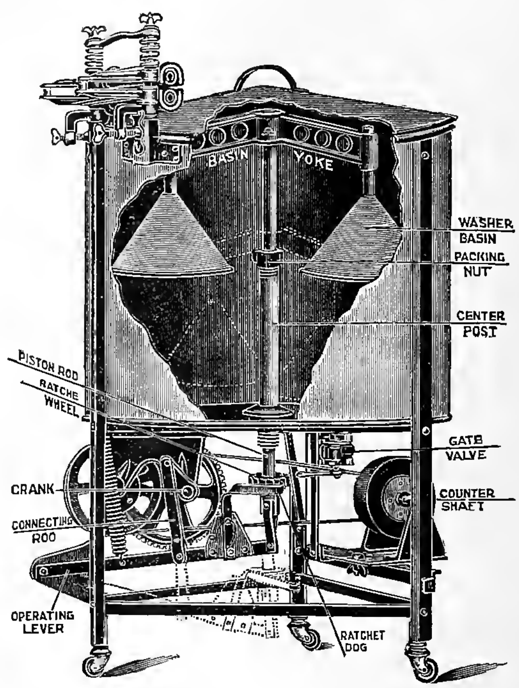
The cable will be in one length of about 9500 ft. and will be submerged to a maximum depth of 350 ft. The order has been placed with the American Steel and Wire Company, who are to install it with one year's guarantee.

At the South Hood's Canal substation there will be a bank of three 500 k.v.a. O. I. S. C. step-up transformers, 13,200 volts with 6600 volt taps for local load, high tension being 66,000 volts, both sides being delta connected.

The switching apparatus will consist of one switchboard panel with suitable indicating and recording instruments with one 3-pole single throw, Burke type pole-top mounting air brake circuit breaker or switch, with fuse attachment. Suitable lighting arresters will be placed at both North and South substations; these being Westinghouse Type "A" electrolytic, 66,000 volt delta connected. The transmission line is 66,000 volt, 3-phase neutral grounded star connected but lightning arresters and transformers are arranged for delta connection which will provide for such surges which will be imposed by faulty or inefficient ground of the neutral, if such ever occurs.

MOTOR-DRIVEN WASHING MACHINE.

The manifold advantages of the electric washing machine for the home have won for it a permanent place in the list of modern labor-saving devices. The principle of washing consists in forcing the soapsuds through the clothes. Before the advent of the washing machine, this was accomplished by rubbing the clothes against a board. The machine illustrated herewith utilizes the above principle by means of a ⅛ h.p, electric motor which raises and lowers two rust-proof metal funnels or cups through the soapy water. These cups are attached to a yoke which is in turn fastened to a center bar by thumbscrews. The bar is backed up by a compression spring that automatically adjusts the position of the cups according to the amount of clothes in the machine. The electric motor is mounted on the frame under the washtub in an accessible place from which it may easily be detached.



Motor-Driven Washing Machine.

The machine is equipped with a wringer, which is also operated by the electric motor through a set of silent, inclosed bevel gears, the power being transferred from the washer basins by a clutch lever conveniently located near the bottom of the tub. This lever can be operated to transfer the power from wringer to washer or in the reverse direction without stopping the motor. The wringer can be reversed by a small lever located near the upper roll. A gas burner for heating the water is also attached to the frame of the washer under the bottom of the tank. This device will heat the usual quantity of water to the scalding point in from twenty to thirty minutes. The entire machine is mounted on channel steel legs and roller-bearing casters. It weighs about 130 lb. and can be conveniently wheeled about the floor. It is known as the "Easy" motor washer.

The Pacific States Electric Company are distributors for the Pacific Coast.

The motor may easily be detached and made available for other household uses, such as operating the ice-cream freezer, vacuum cleaner, food chopper, emery wheels and others.

The Cutler-Hammer Clutch Company of Milwaukee has just issued two new bulletins, one describing circular type lifting magnets and the other magnetic separators. The 48-page lifting magnet bulletin contains many illustrations showing Cutler-Hammer magnets used for a great variety of purposes, inside and out, under water and in snow storms. The magnetic separators described in Bulletin 13,000 are for use in cement mills, paper pulp mills, terra cotta plants or wherever it is desired to continuously remove the magnetic contents from non-magnetic bulk material.

NEWS NOTES

INCORPORATIONS.

DIXON, CAL.—A number of farmers have organized the Maine Prairie Telephone Company, with C. Parker, president, and H. G. Brown, secretary.

SANTA BARBARA, CAL.—Articles of incorporation of the Solvang Water & Irrigation Company have been filed. Directors: Marcus Neilsen, Peter N. Thomsen and A. Christiensen. Capital stock, $15,000.

ILLUMINATION.

GLADSTONE, ORE.--The Gladstone City Council has granted a franchise for 35 years to the Portland Light & Power Company.

LOS ANGELES, CAL.—The people of Wilmington district propose to have ornamentally lighted streets, the same as in Los Angeles proper.

CHICO, CAL.—The Pacific Gas & Electric Company has placed orders for improvements to the Chico substation to the amount of practically $15,000.

YUMA, ARIZ.—Frank G. Townsend and Leandro Goodwin have formed a partnership to engage in business of supplying electric light and power.

CENTRAL POINT, ORE.—The California-Oregon Light & Power Company is to extend its lines from Jacksonville into the Applegate Valley in the near future.

EUGENE, ORE.—The water board has made a proposition to install ornamental lights in the business district and suggest that property owners pay for the installation.

SAN DIEGO, CAL.—Within the next few weeks the San Diego Consolidated Gas & Electric Company will begin the expenditure of $105,000 on extensions of its underground system of electric wiring.

EL CENTRO, CAL.—On petition of the Imperial Valley Gas Company, bids will be called for the sale of a franchise for gas pipes on county roads to cover a large part of the irrigated portion of the county.

BURNS, ORE.—A. Welch, a Portland capitalist, has taken over the electric light plant operated here for several years, and has been granted a 25 year franchise by the city council for its operation, to be ready by the first of 1913.

OLYMPIA, WASH.—Wilbur I. Forbes, representing the Oregon, Washington Railway Corporation, has asked the city council to grant him a franchise to construct an electric lighting system for this city, also a franchise to put in a water system.

DUNCAN, B. C.—C. H. E. Williams, 615 Pender street, W., Vancouver, B. C., has been awarded the contract for the erection of street lights and the installation of a lighting plant for this city. About $9500 will be expended. The contractor is receiving bids for wire, etc.

HEMET, CAL.—The Hemet-San Jacinto Gas Company, which has been owned by a stock company of outside capitalists and managed for several years by Miss Eva Herrington, was sold this week to E. A. McGillivray, a Los Angeles capitalist, who is a builder of complete gas plants and manufacturer of Beale gas apparatus.

SAN FRANCISCO, CAL.—The $600,000 issue of 5 per cent 30-year first and refunding bonds of the Western States Gas & Electric Company, recently authorized by the Railroad Commission, have been purchased by White, Weid & Company, and are being offered to the public at $95 and interest. When the bonds were authorized the commission placed the minimum sale price at $87.50, but it is stated that the company received a considerable advance over this figure. Including this issue, the company has outstanding $3,548,000 of these bonds.

STOCKTON, CAL.—The Railroad Commission has amended an order previously granted to the Oro Electric Corporation, giving it permission to serve certain territory in San Joaquin County outside the city of Stockton. The Western States Gas & Electric Company, which serves the city of Stockton, claimed that it should be entitled to serve a strip two miles wide surrounding the actual corporate limits of the city of Stockton. This strip of territory is generally regarded and spoken of as being included within the city of Stockton. The Commission granted a rehearing upon this point and amended its original order. The Western States was given permission to serve certain parts of this outside strip surrounding what is actually the city of Stockton.

EUGENE, ORE.—A proposition to purchase the municipal power plant was made to the city countil on Ocober 7th by A. Welch. Mr. Welch's proposition contemplated a fifty-year franchise to sell electrical energy in Eugene, and also embodied a specific list of rates that should be charged the city for power for use of the municipal water plant and for street lighting. The city electrical plant includes a 2400 horsepower plant at Walterville, where water is diverted from the McKenzie River and brought three miles and a half to the power plant; transmission line, substations at Eugene and a distribution system for commercial and for street lighting. The whole installation cost about $350,000.

SAN FRANCISCO, CAL.—According to an official the Great Western Power Company is having the largest business in its history. The increase in current generated for the first thirteen days of October is twelve per cent over the current generated for the same period in the month of September. This increase in current generated reflects the large increase in number of customers connected to the system during the last five months. On May 11, 7092 customers, having a connected load of 77,967 kw. were connected to the company's distributing lines. This had increased on October 11, to 9971 customers, the connected load of which was 88,803 kw. In addition to the customers connected the company still has contracted, and is rapidly connecting to October 11, to 9871 customers, the connected load of which will be 10,101 kw. and the estimated revenue from which will be $265,000 per annum. A large part of the added business is in the Northwestern District, including Solano County and a portion of Sonoma County. There has also been a heavy increase at Sacramento and above that city, where there is a great demand for power for irrigation pumping. A large number of electric pumping plants have been installed, the units averaging from 10 hp. to 20 hp.

TRANSPORTATION.

SAN BERNARDINO, CAL.—The Pacific Electric announces that it will expend $25,000 for additional improvments at Urbita Springs.

PARMA, IDAHO.—It is reported that the Oregon-Idaho Light & Power Company of Caldwell will in the spring build an electric railway between Caldwell and Weiser via this place.

SEATTLE, WASH.—The Puget Sound Traction, Light & Power Company have begun the double tracking of the Fauntleroy line. The line will be double track as far south as Myrtle street or Gatewood for the present.

RIVERSIDE, CAL.—Chief Engineer Pillsbury of the Riverside Electric is authority for the statement that work on the Riverside-San Bernardino trolley line will begin within 30 days and that the line should be in operation within 4 or 5 months.

SANDY, ORE.—A contract has been let for surface clearing of the rights of way for the Sandy extension of the Mount Hood Railway, between this place and Cottrell. A contract has been let also for the 900 feet of piling for the trestle necessary.

SAN FRANCISO, CAL.—An amicable undertsanding has at last been reached between the city and the United Railroads whereby the latter will allow the Geary street municipal tracks to be extended to the ferry in consideration of its continuance of the Sutter-street franchise.

SAN FRANCISCO, CAL.—As a result of a visit of inspection by public works commissioners and Secretary Churchill to the scene of the W. L. Holman Company's carbuilding operations, the force of workmen is to be still further increased, to the end that the first batch of 20 cars may be completed by Christmas and ready for the municipal road. From now on men will work on all holidays and there will also be night shifts.

RICHMOND, CAL.—The Southern Pacific Company has applied to the Railroad Commission for permission to purchase a railroad franchise granted by the city of Richmond to H. G. Cutting. Cutting has done no construction work under this franchise and the Southern Pacific Company wants it to complete an electric interruban system which will join the cities of Richmond, Albany, Berkeley, Oakland, Alameda and other points in the southern part of Alameda County.

EDMONTON, ALBERTA.—Official announcement is made by M. Kimpe, managing director, that the Edmonton Interurban Railway Company, incorporated in 1910, and reorganized on September 16 last, will build 300 miles of electric lines to connect Edmonton with numerous towns in Central Alberta. J. W. McLeod, contractor for construction, has 150 men on the grade for the first unit of six miles from the northwestern city limits to St. Albert, where a power house, with sufficient capacity to operate 26 miles of line, will be erected. Steel will be laid the coming winter and it is planned to have the line in operation early next June.

SALEM, ORE.—The annual report of the Portland, Railway, Light & Power Company, of Portland, Ore., to the State Railway Commission, has beeen filed. It covers the fiscal period from June 30, 1911, to June 30, 1912. The company operates in 14 cities and towns in Oregon. It has 293.5 miles of railway, and electric lighting stations in all the towns in which it operates.

The net increase, out of which must be paid taxes, bond interest and depreciation on the railway division, on June 30, 1912, for the year preceding, was $1,440,487.97. The net income of the light and power division was $1,851,804.08. The operating expenses of all divisions amounted to $2,117,414.19 and the taxes, interest on bonds and depreciation amounted to $2,276,696.01. The 4 per cent divideud amounted to $999,977.50. This left a net balance to be carried to surplus account of $440,510.47. The railway revenues were received from the interrurban lines to Estacada, Oregon City, Troutdale and Mount Hood, each being separate lines, and the street car lines in Portland. The passenger car mileage for the entire system is reported as 14,704,845. During the yar there were 68,489,930 passengers carried. The average fare paid by all persons traveling upon its lines both interurban and city, was 3.9 cents. The company reports a total number of passenger cars at 644. The company has 302 freight cars , and its total number of cars is 1157. Two persons were killed and 19 injured during the year ending June 30, 1912. There is a total railway mileage operated by the company of 293.5 The bonded indebtedness is placed at $39,000,000.

TRANSMISSION.

BURNS, ORE.—A. Welch has been granted a franchise for the operation of an electric lighting and power plant within the city for a period of 25 years.

DIXON, CAL.—The Great Western Power Company has been granted a franchise to transmit electricity in the town of Dixon for furnishing light, heat and power for the period of 50 years.

REPUBLIC, WASH.—The power line of the Washington Water Power Company is to be extended from the plant of the company on Spokane River, known as the Long Lake plant, to Republic to serve the mines and mills of the camp.

GARDNERVILLE, CAL.—The brick work on the new building of the Douglas Milling & Power Company at Gardnerville has been completed. It is planned to enlarge the power plant at a later date and eventually to extend the lines to many parts of the valley.

MILTON, ORE.—Muncipal Manager L. E. Coyle and County Surveyor Geary Kimbrell have been making a survey and estimate of the cost of constructing the barrel flume which furnishes water to run the light and power plant. A $10,000 bond issue is to be asked for constructing same.

HOOD RIVER, ORE.—The Northwestern Electric Company, now constructing a dam on the White Salmon River opposite here, may lay a cable across the Columbia River to this place and follow the Oregon side of the river to Portland where the company expects to furnish light and power.

TELEPHONE AND TELEGRAPH.

HOLBROOK, ARIZ.—More telephones will soon be installed in Snowflake and considerable improvements made, both in service to subscribers and to lines.

EVERETT, WASH.—A franchise has been granted the South Fork Telephone Company to operate a telephone line along portions of the Snohomish county roads.

CALDWELL, IDAHO.—It is announced that the power line of the Oregon-Idaho Light & Power Company will construct a high tension power line from this place to Parma.

PORTLAND, ORE.—Permission has been granted to the Pacific Telephone & Telegraph Company to proceed with the construction of its 14-story fire-proof, reinforced concrete building at Park and Oak streets.

RENO, NEV.—Not only will the Pacific Telephone & Telegraph Company surely erect a substantial building in Reno within a short time, according to N. J. Pendergast, but new switchboards and equipment will be installed that will anticipate the growth of Reno for several years.

WATERWORKS.

MADERA, CAL.—M. C. Knowles has been granted the water franchise for the city of Raymond.

SNOHOMISH, WASH.—The council has decided to commence active operation on the construction of the water system across the river.

VENICE, CAL.—A special election to vote $100,000 in bonds to extend salt water fire main, will be called in Venice some date in November.

SUISUN, CAL.—A special election will soon be called to vote upon the propostion of issuing bonds to raise money to build about two miles of pipe line for the municipal water system.

PILOT ROCK, ORE.—Money for the water bonds issued by the town of Pilot Rock, and sold to the American Water & Light Company, of Chicago, has been reecived and work will be commenced on the installation of a water system for the town.

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POWER AND GAS

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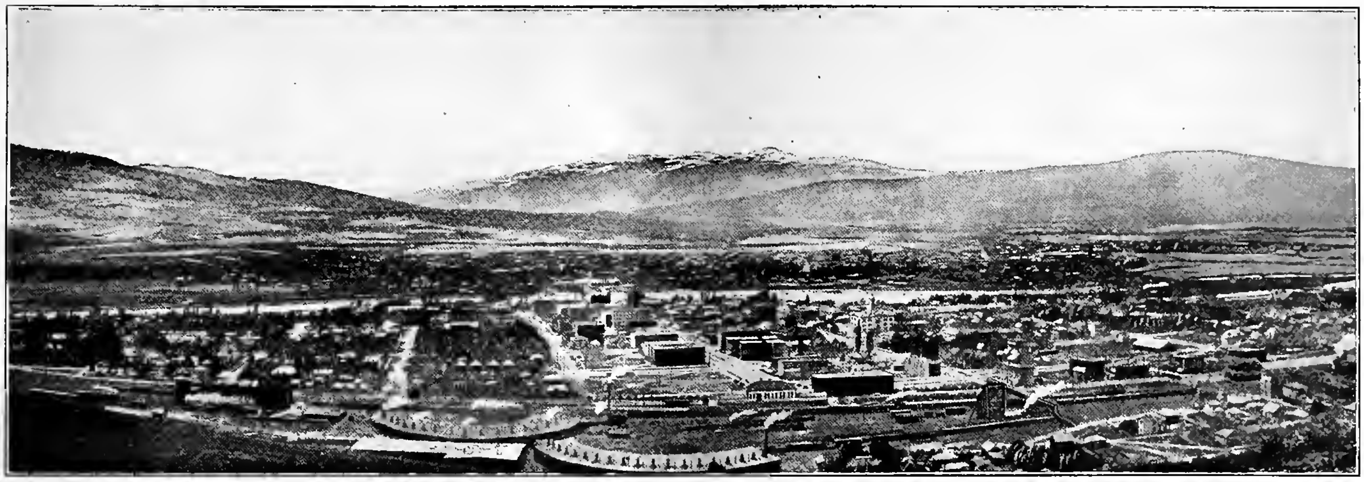


Missoula, Montana.

ONE-MAN CAR OPERATION IN MONTANA

The operation of a prepayment car by means of one man fulfilling the duties of both motorman and conductor offers upon first consideration many possible misgivings. Before the mental vision of the busy traffic manager arise doubts as to whether accidents would not be prevalent under such a system, that rowdyism and stealing rides would thereby be made possible and even painful thoughts arise as to what might happen should the motorman, the sole operator of the car, become suddenly sick or even die. It has remained for one of the enterprising cities of western Montana to actually demonstrate the fallacy of such painful forebodings with the result that three years of trial has awakened in the community served by this system a wholesome public attitude, firm in its approval of the system, and among the employes of the company the resulting higher pay and responsible direction given to the man operating each car a well-defined esprit de corps seldom brought about elsewhere. Sydney R. Inch, general manager of the Missoula Street Railway Company, is responsible almost entirely for this efficient evolution in car design and operation. In the following lines may be found an abstract of Mr. Inch's paper recently presented before the Chicago convention of the American Electric Railway Transportation and Traffic Association, wherein this unusual accomplishment is set forth:

While the operation of one-man cars is not new, it is only within the past three years that a type of car has been developed which has made such operation free from difficulty and danger, and has not only secured economy in platform expense but has also provided adequately for the safety of the public, the collection of fares, and the maintenance of reasonably fast schedules.

Until very recently, the operation of one-man cars was limited to the smallest systems or to very unimportant feeder lines of the larger systems, where, if need be, cars could be stopped while fares were being collected, or where the company was willing to take long chances by having the motorman run the car at a slow rate of speed and then leave his controller and collect fares while the car was in motion.

The defects of the system when so operated were so many and so obvious that the use of the one-man cars fell into merited disrepute.

Recent experience, however, seems to prove that in most cities of 50,000 people or less one-man prepayment cars can be operated under the same schedules and handle the same traffic as two-man cars of the prepayment type with the positive advantages of greater freedom from accident and reduced operating expenses.

In order to secure such a result, however, it is necessary to go to the other extreme from the dilapi-

dated equipment, the poor track and the ragged overhead work which often characterized the one-man systems of the past, for the successful one-man system of today will need to be equipped with first-class rolling stock and the track and overhead work of the one-man system will have to be maintained at all times in good condition.

There are now several places where one-man prepayment cars of the general type recommended are in use, but so far as I know the first system to be designed specially for one-man operation along these lines, and to be operated continuously and exclusively as such, is the one with which I am connected, one of a number of public utility properties in Montana owned by William A. Clark.

The lines of the Missoula Street Railway were built in 1909, and the one-man car which we use was designed in April of that year. The problem which we set ourselves to solve in its design was the reduction of operating expense without any corresponding sacrifice in matters of safety and schedule. The question of operating expense was, as everyone who is familiar with the inter-mountain states will believe readily, a very serious matter indeed with us, for wages in Montana are from 50 per cent to 100 per cent higher than in either the Eastern or the Pacific Coast States, while income is based on the universal 5-cent fare and therefore is no greater than elsewhere. It was very evident that unless operating expenses could be cut materially below the ordinary figures, we could not expect to pay our way, and this meant that we must reduce to a minimum the number of men employed. This we did in two ways: first, by the elimination of the entirely unnecessary conductor, adding his duties to those of the motorman; and second, by adopting reasonably fast schedules and reducing lay-overs to a minimum in order to give good service with relatively few cars.

Double-Track Cars.

In order to maintain safety the fast schedules necessary for reasonably good service in a scattered district operated with comparatively few cars, and to do so with comfort to our passengers, we adopted double-truck cars exclusively, and equipped them all with air brakes.

City cars are double-end, thirty-two passenger Brill semi-convertible cars, 39 feet 9 inches in over-all length, mounted on maximum traction trucks, and equipped with two G. E. 210 interpole 600-volt motors.

On our interurban line, we use a single-end, fifty-two-passenger car, 46 feet in over-all length, mounted on M. C. B. trucks and equipped with four motors of the above-mentioned type. Steel wheels are used throughout, driving wheels being 33 inches in diameter. The gear ratio on all cars is 15/71.

Arrangement of Platform.

The platforms are 6 feet long and are arranged so that passengers board and alight at the same platform and at the same side of the car. The double folding vestibuled doors, together with corresponding folding steps, are operated by hand levers under the control of the motorman, and on some of the cars the bulkhead doors are controlled in a similar way. On the platform is a Brill 4A fare box. Railings are used to divide the platforms into three sections for boarding and alighting passengers and the motorman, respectively. There are no grab handles visible when the car doors are shut, and the steps fold up so as to afford no foothold; the bumpers are provided with inclined metal shields to prevent persons from riding on them and the vestibule windows are guarded to prevent people from climbing in at the rear end of the car to avoid paying their fare. The rear platform is used as a smoking compartment, the doors being locked securely.

The floor plan of our standard car, published herewith, will give a good idea of the special platform arrangement.

System of Operation.

The car is brought to a complete stop before the doors are opened, and the doors are closed before the car is started.

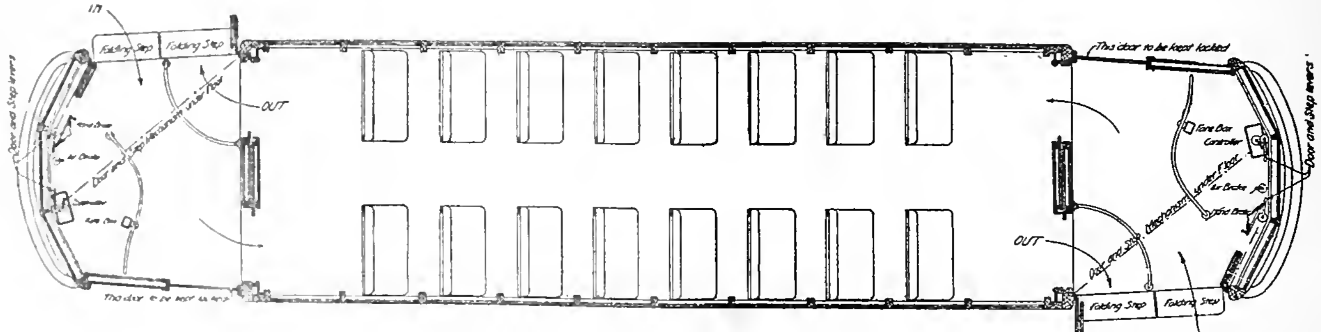
The cars stop at the near side of intersecting streets, which places the front platform opposite the sidewalk, and are not stopped to take on or discharge passengers except at street intersections.

Push buttons placed in every side post enable passengers to signal the motorman.

Fares are collected by means of a fare box, and the motorman is required to make change and issue transfers, which must be asked for when the passenger pays his fare. We have adopted a method of run rotation, so that each man's receipts are checked by the receipts of other men on the same run. The plan has worked satisfactorily, not only by permitting comparisons, but by preventing undue familiarity between motormen and regular passengers.

Schedules.

With the cars so operated and with a working day of eighteen hours, city cars make an average of 4,300 miles per month, while on the semi-interurban lines a



Floor Plan of One-Man Prepayment Car.

car makes an average of 8,800 miles per month. The schedule speed on the city lines, including lay-overs, is practically 8 m. p. h., and on one of the interurban runs is 16.4 m. p. h.

The regular headway on the city lines is fifteen minutes, but our lines are so arranged that nearly all cars pass through the center of town, where we have laid double track. This arrangement gives us a five-minute schedule for three-quarters of a mile through the down-town section.

Accidents.

It will no doubt be acknowledged that for all systems attempting fast schedules the use of cars having closed doors and folding steps is desirable. For the one-man system, the use of cars of this type may be considered essential, and, as with two-man systems, the number of platform accidents will be thereby greatly reduced.

It is, I think, fair to claim for one-man cars so equipped, and with passengers boarding and alighting at the front platform under the immediate observation of the motorman, a distinct and positive advantage for the one-man car as compared with the ordinary two-man car, for it removes the division of responsibility as to the starting of the car which has been such a frequent cause of platform accidents.

In the past two and a half years our cars have made nearly a million car-miles, practically without accident and absolutely without a single accident which could in any way be charged to one-man operation.

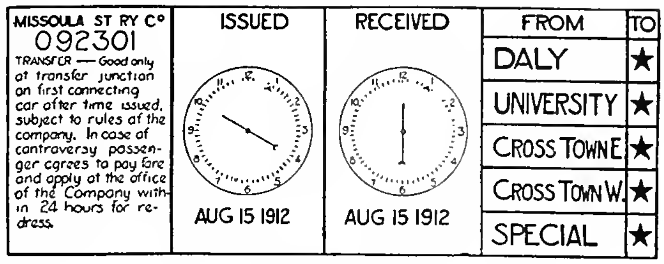
Handling Traffic.

However, the faster speeds at which closed platform cars may be operated safely makes the net delay very small even in large cities, and since the delay to one-man cars from this cause is no greater than in the case of two-man cars, it becomes altogether negligible in any place where the use of one-man cars would be feasible.

On many occasions, we have had 120 passengers on our thirty-two-passenger cars, with the car in charge of one man as usual. With most small systems. however, the handling of large standing loads is unfortunately rare and the one-man car is not recommended for places where such profitable conditions are the rule rather than the exception.

Making change and issuing transfers sometimes cause slight delay, but much less than might be thought and certainly not enough to be a serious disadvantage. While the use of tickets would be of some advantage to us as saving the delay incident to making change, we have not found delay of this kind sufficient to cause us to offer tickets for less than 5 cents straight.

The issue of transfers might be more serious, however, where the number issued is large and where the usual transfer is used. Delay from this cause can be avoided largely by the use of transfers specially prepared for the purpose. We have devised a transfer which suits our conditions very well. This is illustrated herewith.



One-Man Prepayment Car Transfer Form.

Other Criticisms.

It has also been suggested that with the one-man system it would be impossible to deal with rowdyism on the cars and to prevent people from stealing rides. It is our experience that the latter trouble can be prevented altogether by the proper construction of the car and, although one of our lines runs to a military post, another to a large lumber camp, and still another to a state university, we find that all these lines are served satisfactorily with one-man cars and that trouble of the kind mentioned is exceedingly rare.

Another criticism refers to the possibility of the sudden illness or death of the motorman. Exactly the same criticism applies to the operation of most interurban lines, where the motorman is so separated from the rest of the crew that they would probably not know of any such mishap to him for some time, and in a lesser degree to the operation of ordinary city cars, where it is quite possible that the conductor would not immediately know of the motorman's condition. The fact is that the possibility of such an accident is so very remote that it does not have much consideration in any surface system. However, if it was thought desirable, it would be quite feasible to develop a "dead-man's handle" for the Type K controller used commonly on city lines, and, in addition, to use automatic stopping devices in connection with signals on interurban lines.

At first we did have a good deal of trolley trouble, but it has been avoided almost entirely by putting a trolley pole at each end of the car, located immediately above the king bolt of the truck, by the use of trolley catchers, and, most important of all, by the use of Detroit type trolley frogs located very carefully and securely. We also find that the use of 6-inch high-speed, deep-groove trolley wheels throughout is of some advantage. It is now a rare occurrence for us to have a trolley leave the wire.

Attitude of the Public.

We anticipated much more trouble from this source than we actually experienced and what little we actually had was of very short duration, and has now died out altogether. The public has found that no accidents have resulted from the one-man plan, and apparently realizes too that the system has enabled us to give better and more frequent car service than we would be able to do otherwise. We have appealed to the enlightened self-interest of the public and have found by a frank discussion that the benefits of more lines and more cars which the reduction of operating expense due to the one-man plan has made possible

are now well understood in our community and that following this understanding has come public indorsement.

I feel that the satisfaction of the people of Missoula may be taken as the ultimate attitude which the people of any town would take where the system was properly applicable and properly introduced.

Attitude of Employees.

In order to gain the men's support, we appealed, as in the case of the public, to their self-interest; first, by paying a bonus of 5 cents per hour for one-man operation, and second, by so equipping the cars as to reduce the labor of running them to a minimum. The result has exceeded our expectations and now the men themselves are as enthusiastic about that one-man idea as the officers of the company could wish.

It is no doubt a fact that less prejudice on the part of the public and less antagonism on the part of the employees to departures from the ordinary method of operation are to be expected in the starting of a new street railway system, such as ours, than in making changes of a similar character on an existing system.

It is, however, easy to over-estimate this advantage, for the population of any town where a street railway would be built is composed largely of people who are familiar with ordinary methods of street car operation, and who, consequently, will view any innovations of a radical nature with a good deal of suspicion.

I think that companies now operating two-man cars that might try the operation of one-man prepayment cars would find the fact that several such systems are now in successful operation would be of greater advantage to them in attempting to introduce one-man cars than the fact that our system was installed where there had not previously been any car service was to us.

Results.

In Missoula and its surroundings, with a total population of about 17,000, the Missoula Street Railway, using one-man prepayment cars over an equivalent of 19 miles of single track during the past two and a half years under reasonably fast schedules, has operated profitably eight regular double-truck cars, carried, including interurban business, over 2,500,000 passengers, and run nearly a million car-miles without a serious accident.

Notwithstanding that carmen's wages in Montana are probably higher than anywhere else in the United States, being from 35 cents to 40 cents per hour in Missoula, according to length of service, operating expenses have been kept below 14 cents per car-mile, and it is believed can be reduced still further.

This makes an interesting comparison with the figures given in the United States census of street and electric railways in 1907, where the average operating expense for all systems having a gross income of less than $500,000 a year was shown to be 16.8 cents per car-mile. The census figures are based upon the average rate paid throughout the whole country to motormen and conductors, which is less than 70 per cent of the average rate paid in Montana. These comparisons appear to show that if in Montana one-man cars can be operated for 14 cents per car-mile, very much lower unit costs should be obtainable in places where carmen's wages are nearer the average rates.

Our annual saving, due to one-man operation, is now about $15,000 a year, and this will increase as the system grows, as it must do in a town which has trebled its population between the census of 1900 and that of 1910.

It is my belief that similar results can be obtained by any company operating in a town or city of, say, 50,000 population or less, under ordinary conditions, and that in such a case it is probable all the lines could be well served with one-man cars. It also seems probable that many of the larger systems could adopt the plan safely for suburban lines which do not go through the downtown districts.

The fact that in St. Paul and Minneapolis cars having platforms closed while in motion have been used successfully for many years may be taken to dispose of the criticism that this feature of our plan is not feasible in the comparatively small cities for which one-man cars are recommended. Reference may also be made to the instant approval which the traveling public accorded to the near-side car adopted recently in Philadelphia; this car, while used in Philadelphia as a two-man car, having the conductor stationed on the front platform with the motorman, would seem to make an excellent one-man prepayment car for places where the traffic is light. This car, in all its main operating features, seems to be very similar to the Missoula car, although the platform arrangement and general construction of the Philadelphia near-side car are quite different from the Missoula car.

Considered together with the excellent results obtained by other systems using one-man cars, the success of the Missoula car would seem to go far in support of my contention that in most towns and cities of comparatively small size the use of cars operated as described will make the employment of conductors an unnecessary expense offering no compensating advantages.

GOOD ROAD MEASURES FOR OREGON.

Recommendations that three of the "harmony" road bills proposed by initiative at the coming election be voted for and that the bills prepared by the state grange committee be voted against was passed recently by the Oregon Society of Engineers at a business session following its quarterly dinner at the Imperial Hotel. The action was taken after a special committee composed of T. M. Hurlburt, city engineer of Portland; W. P. Hardesty of the city engineer's office, and O. Laurgaard, a leading irrigation project engineer, had made an extensive study of all the road bills submitted to the judgment of the people and filed its report. Great interest is being manifested in this matter by all Oregon engineers. Frank B. Riley, state vice-president of the Pacific Highway Association, has addressed several meetings of engineers and it is hoped that this campaign will result in a magnificent system of roads for the state.

USE OF ELECTRIC POWER FOR IRRIGATION AND OTHER RURAL PURPOSES.

BY GEORGE C. ARROWSMITH.

(Concluded.)

In different localities different quantities of water are required on account of the difference in soils; and although at present the loose sandy soils appear to require more water than the clayey soils, I believe that methods of irrigation will be worked out so that the sandy soils will take less water than the clayey, and think that very early spring watering will be a great saver of summer water by reason of the fact that water is drawn back to the surface by capillary attraction more in the sandy soil, resulting in the use of power before and after the real season.

This may not—and does not—hold good on newly planted land as the extreme surface dries up so quickly that new crops, having such shallow roots, require more frequent application and hence more water. This sometimes calls for the installation of larger plants than is necessary, but in the majority of cases is taken care of automatically. For instance: A customer has 80 acres of land and purchases a plant to furnish 30 acre inches thereon every season. He cultivates 40 acres and perhaps uses his entire plant delivering 60 inches on the 40 acres for the first season; but after the first season the 40 acres will take less water and he cultivates, say, another 20, using the entire plant for this, and so on until he is using the plant to deliver 30 acre inches on the whole 80, as originally intended, which enables him to purchase a plant of the right size in the first place but costs him more for power per acre for the first few seasons.

Testing Apparatus.

The testing of apparatus, both for input of power and output of water, should be carefully attended to, for the power companies' sake and for the protection of the customer, and other data such as the capacity of apparatus, number of acres cultivated, etc., kept of record for ready reference. The testing of apparatus in isolated districts, and especially where apparatus has not been right has been a source of tremendous expense to power companies, in that repeated visits have had to be made, but with the standardization of apparatus this expense will be brought to a minimum.

Relative Costs Electric Power, Gravity, Gasoline, Distillates, Steam, Etc.

From sources of water supply that have not already been appropriated or apportioned so that the irrigator does not have to purchase a water right, the use of electric power and pumping machinery in independent units possesses great advantages over irrigation by gravity canal or by large pumping units where water rights have to be purchased at high cost and maintenance paid, in that the first cost of pumping machinery comes to far less per acre than the purchase of a water right, the interest on which water right alone is more than the interest, depreciation, maintenance and power, of an electric unit. Also the maintenance charge on the gravity supply is subject to change, according to the cost of operating and maintaining the canal, which may be altered considerably, whereas the power charge must remain the same. Take for example the following:

Irrigation by Gravity.

Cost of water right, $100.00 per acre, making at 8% simple interest forever a fixed charge per acre	$ 8.00
Usual maintenance charge from average of a number of canals	2.10
Total cost per acre year on average canal	$10.10

By Electric Power.

(10 H.P. plant, 50 ft. head, delivering same water duty as gravity canal.)

Cost of plant complete, with well, etc., for irrigating 122 acres, $825.00, or per acre cost of $6.75—Interest at 8% on $6.75	$0.54
Depreciation at 12% on $6.75	.81
Maintenance of machinery, 10%	.67
Power bill per acre	3.29
	$5.31

Making a difference in the favor of the pumping system of $4.79 per acre season which, from a monetary standpoint alone, will enable the land owner to pump the same amount of water that the gravity canal will supply him, to an elevation of 100 feet, at the same cost of gravity water.

Also independent pumping enables him to pump water earlier or later in the season than delivered by gravity canals, which is often considerable advantage; puts land under irrigation that is inaccessible to gravity canals, and puts all independent of any general irrigation scheme.

At present there are a great number of gasoline engines throughout the country pumping water, and successful results have been obtained thereby; and these outfits are not to be generally belittled, but the electric power should—and will—supersede these entirely, as lines are extended and the reliability of electric power becomes thoroughly known. Ease of operation, reliability, and cost of operation go a long way towards boosting the sale of electric power and apparatus, as against the use of gasoline or distillate power, and though electric power has so many general advantages on its side, still, at the same time, there are conditions existing right under power companies' lines that are, owing to the fixed charges necessary to electric service, hard to meet in competition with gasoline and distillate, as will be seen from the accompanying comparative duty curve of electric, gasoline and distillate powers.

From this daily curve, which is purely a current cost as against fuel cost, eliminating all other charges attendant on the use of gasoline, such as repairs, oil, batteries, not to mention "bad language," it will be seen that for daily use throughout the season, or at any time during the month that goes to make a load factor of approximately 16½ per cent, the fuel cost of gasoline and current cost per horsepower hour are the same, and at a load factor of approximately 32 per cent the fuel costs of distillates and current costs per horsepower hour are the same. However, these fuel consumption figures are generally laboratory tests, or at least what are obtained when apparatus is new and under skillful operation, and are very rarely obtained in actual practice and allowances can safely be made to increase the fuel consumption of gasoline and distillates 20 per cent.

In the irrigation of land, especially small tracts, there are many irrigators who install a comparatively

large unit and who use the same on a season load factor of as low as 7 per cent which makes it difficult to contract for power, especially when the irrigator already has his own plant installed and paid for. I think that power companies might do well to get in touch with some second hand dealers who would be willing to purchase these outfits at a reasonable price, which would result in the substitution of electric power for gasoline in many instances.

The vagaries, and the trouble and expense of operating gasoline engines, particularly by unskilled hands, are so well known that it would be superfluous to enter into the subject here, still, their ability to compete with electric power should not be underestimated.

There have been quite a few producer plants installed but, owing to the grade of coal obtainable in the Northwest, the high installation, maintenance, and labor costs they cannot compete with electric power and have been displaced in every instance.

The Diesel engine being comparatively new, and the cost of installation and attendance for small units being so high, need not be considered; but for large units may become a keen competititor of electric power.

As the production of steam power by fuel oil or coal is necessarily confined to large installations, and the conditions governing the cost of production so varied, and estimates so extensive, a discussion of the relative costs here would take too much space; but it should not be difficult for any power company to obtain a large contract for power on a profitable basis as against steam, especially on new installations.

The Power Contract.

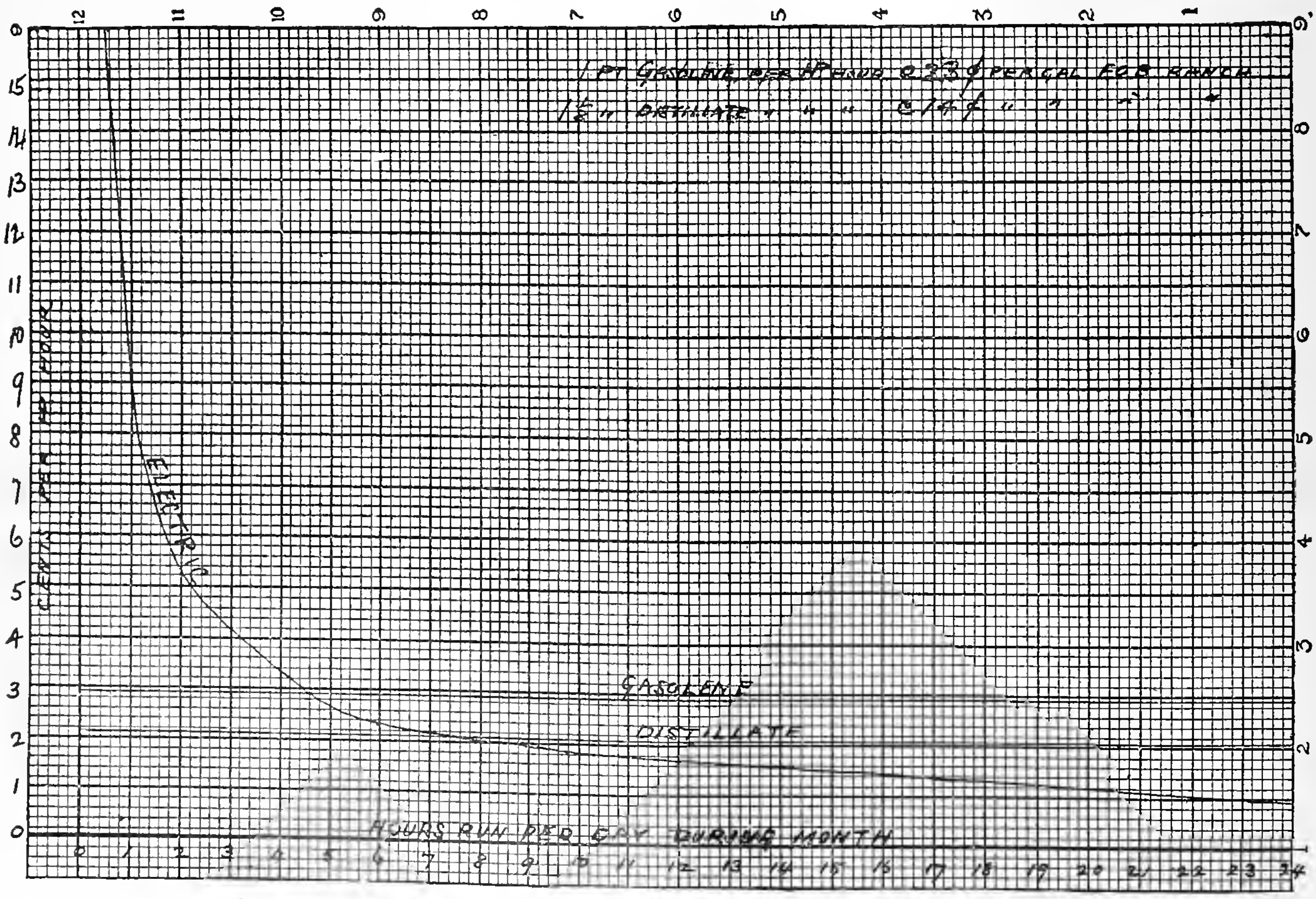
The power contract should be made for ten years oı as short as five years, as condensed as possible, and owing to the fact that power companies must be consistent, all customers should of course be treated alike; should be so arranged that the power bill will constitute a lien on the property, just the same as any water right, and think that the lien on the property is enough to secure the company from loss; and being that this is the case and is generally a "bugbear" to the customer, yet is easily explained to him. It is superfluous and only aggravating to have the contract constitute a lien on the pumping apparatus also, and as the lien on the real property is already sufficient, it is hard to make it appear consistent to a customer. And, finally, the contract should be made as little one-sided as is consistent with good business and fairness purely as a public utility corporation.

The Contract Agent or Solicitor for the Power Co.

The contract agent for the power company (whether or not the company furnishes apparatus) should be a man who is technically able to correctly estimate anything pertaining to the following:

Prime Mover Electric Power.
Prime Mover Steam or Oil Power.
Prime Mover Gasoline or Distillate.
Prime Mover Water Power and General Hydraulics.

Pumps—Amount of power required.
Efficiency.
Appurtenances.
Class of installation best suited to customer.



Curve Showing Comparative Duty of Electric, Gasoline and Distillate Power.

Water—Pipe lines for supply or distribution.
Best methods to obtain from supply.
Amount of water duty for different soils and crops.
Ditches and pipe laterals.
General usage.

In short, would be a "special" man in the irrigation business, as there is no telling at what moment, in the field and without technical aid, he may be called upon to answer questions pertaining to the foregoing; and on his ability to answer questions may depend the securing of a power contract, either in competition with other forms of power or not; and it should be the duty of the power company to examine the contract agent as to his capability of filling such a position unaided in the field so that any statements he may make may, upon question, be substantiated. His personality should be such that he establishes confidence between himself and the customer, and having secured such confidence he should be sure not to abuse it; and should any question arise as to the truth or consistency of his statements it should be thoroughly investigated by the company, and if found correct the company should back him to the "limit." And any misstatements—either by accident or design—should be treated accordingly, as upon the ability and veracity of the agent depends a great deal of the power company's success in the irrigation field.

Advertising.

As heretofore in this treatise stated, there are a great many installations in operation that, owing to inefficiency and poor design, are not very good advertising for the power companies, and think there could be no cheaper way of advertising than to see that the apparatus is right; and should this be done, do not think any expense should be incurred in general advertising as a satisfied customer is the kind of advertising that talks. The power companies, to hasten this happy result, should supply its agent with one working example of the highest class in each district covered by him.

General Utility, Power, and Effect on General Health, Etc.

Up to date, being that in the Pacific Northwest the supplying of irrigation power is comparatively new, there is not much power being used on the farm for other than irrigation purposes; and while the effect of added cultivated area has somewhat increased the general commercial light and power loads, the extent of this effect is not known but is surely there.

The possibilities for the use of power on the farm in the arid regions are greater than any other and will develop to a large degree as soon as the customer gets the irrigation end right, and becomes more accustomed to the uses of power, and believe that current will be generally used for supplying domestic and stock water, grinding alfalfa, sawing wood, spraying trees, and of course lighting. And here again electricity plays an important part in serving mankind, in that it will put the farmer on the same plane of modern domestic conveniences as his city brother. The statistics gathered by the United States go to show that the chief drawback in farm life—especially for the housewife—is the lack of running water and modern sanitary conveniences, which drawback is eliminated by having power, which takes the place of the city water main. And as such sanitary conveniences are installed, so will the general health of a district be improved, to say nothing of the lessening of the household burden.

This brings up a discussion as to the installation of direct connected units as against belt connected, which would require considerable space to treat fully; yet as the supply of water for irrigation and domestic purposes is most important and of all year demand, and the efficiency of the direct connected unit is some 10 or 15 per cent greater than the belted, and irrigation constitutes by far the largest percentage of the total yearly consumption, would hold for a direct connected unit, which also has other operation and maintenance charges. However, different conditions should be thoroughly considered by and between the power agent and the customer.

In irrigated districts water supplied from shallow wells is subject to pollution from seepage and drainage; and here again the power company might do a good deed for the community by invoking the aid of the State Health Department and have them extend its field of usefulness and establish rules for right sanitation in such districts which, while the immediate necessity may not appear to be wanting, yet as districts become more populated will be a matter of necessity, and from such action during the development of a district a lasting benefit result, and indirectly work to the advantage of the power company, because there is nothing that will hold back a district and keep money out of it, like flies, filth and fever, the fame (?) of which, while generally originating in the country districts is, by the outside world, accredited to nearby towns with derogatory results that again work, undeservedly, against the power companies.

Existing Loads and Future Business.

Although, as heretofore stated, there is but a comparatively small amount of power being used for irrigation purposes, it is only comparative on account of the vast amount of this class of business that is awaiting development on lines that will prove satisfactory to the power companies upon right exploitation, and to give an idea of the magnitude of the opportunity, would say that a conservative estimate of the power required to irrigate land in Yakima, Benton, Walla Walla, Franklin, Grant, Douglas and Chelan Counties alone of the State of Washington amounts to not less than 90,000 horsepower, the supply of water necessarily, in every case, being immediately available, and predict that this amount of power will be in operation within the next ten years.

Again, the counties mentioned comprise only a small portion of the total area available in the State of Washington, to say nothing of the vast areas in Oregon and Idaho, and the effect on the general prosperity of these states by the utilizing of such an enormous amount of power will be tremendous, especially to the commercial and lighting loads of the power companies.

HYDROELECTRIC POWER PLANTS IN CALIFORNIA.

Discussion of paper by J. D. Galloway presented before San Francisco Section of the American Institute of Electrical Engineers, September 27, 1912, and published in these columns October 12, 1912. The following participated in the discussion:

A. H. Halloran, Chairman.

Geo. J. Henry, Jr., consulting engineer.

H. Homberger, consulting engineer.

S. L. Berry, consulting engineer.

C. L. Cory, consulting engineer.

P. T. Hanscom, general superintendent Great Western Power Company.

J. D. Galloway, consulting engineer.

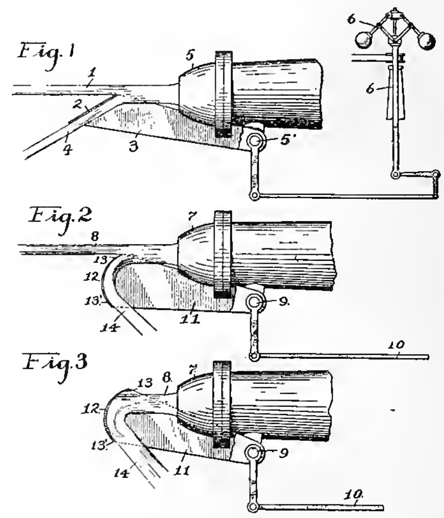
Chairman: We have all enjoyed this interesting and instructive paper of Mr. Galloway's. There are a number of points developed in the paper which are worthy of discussion, perhaps, first from the historical side, and later from the point of view of the various recommendations which Mr. Galloway's experience has shown are justifiable, particularly the mooted question of riveted pipe versus lap-welded. We have with us this evening several who have been pioneers in the development of hydroelectric practice on the coast, among whom is Mr. George J. Henry, who will open the discussion.

Geo. J. Henry, Jr.: I would be glad to shed any light I can on the subject that Mr. Galloway has so ably handled, but I would like to enter into the discussion later when I have heard some of the gentlemen who are more vitally concerned with the use of the apparatus. My experience has been more in the design of hydraulic equipment, and I am always very glad and feel that I get the best possible information to help me in my work from engineers who put the plants in and operators of the plants.

Mr. Galloway during the last few moments here mentioned the by-pass nozzle as a recent outgrowth. It has come into prominence in recent years; but my first knowledge of it was in connection with the proposals for the Nexaca plant in Mexico, the order for which was placed in 1901 or 1902 in New York. I was in New York at that time in connection with the designing of that plant and the proposals that my company put in; and we designed and recommended for their use the by-pass nozzle. The European makers, Escher Wyss, also designed and recommended a by-pass nozzle for use at that time. They used the rectangular form of nozzle; that is, it has a rectangular outlet, and, of course, they furnished a tangential wheel bucket corresponding to this stream shape. The Necaxa plant was built and equipped with by-pass nozzles.

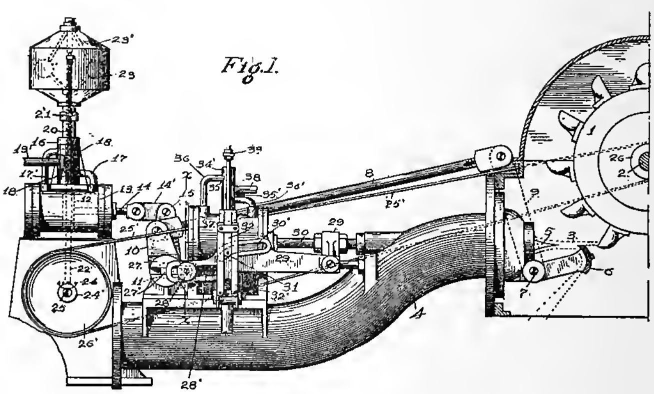
The next step was the Animas plant in Colorado. My company built and installed by-pass nozzles in that plant. The nozzle shortly afterwards jumped into prominence and has been used ever since.

There is, however, a further development in nozzle design, and I have put in several nozzles of a more complicated construction than the by-pass form and in some cases more expensive to install. The reason we went to further complication and expense was to eliminate water hammer or increased pressure that does occur in using the by-pass form of nozzle. There is no doubt but that the by-pass form of nozzle as frequently used today, in which you have a needle actuated by a governor directly connected through the dash pot with a secondary needle actuated in a reverse direction and slowly closing, is all right on short pipe lines; but when the pipe line is several thousand feet or more, as is so frequently the case, the by-pass form of nozzle begins to cause pressure waves, which are disastrous to good regulation. Especially on long pipe lines has this been the experience. We got up a form of nozzle, however, to give automatic and perfect regulation with any length of pipe line, and at the same time to effect the greatest possible water economy. To get accurate speed regulation you must quickly throw off or on your full jet of water from or to the buckets of the wheel; and I think it is generally conceded you must do that in from a second to two seconds of time. When dealing with large units, to throw four or five or six thousand horsepower off or on to the buckets of a water wheel in a second or two seconds' time means rapid work on the part of the governor, and, if you use a by-pass form of nozzle, extremely rapid fluctuations of the needle, and disastrous pressure waves.



Counterbalanced Stream Deflector.

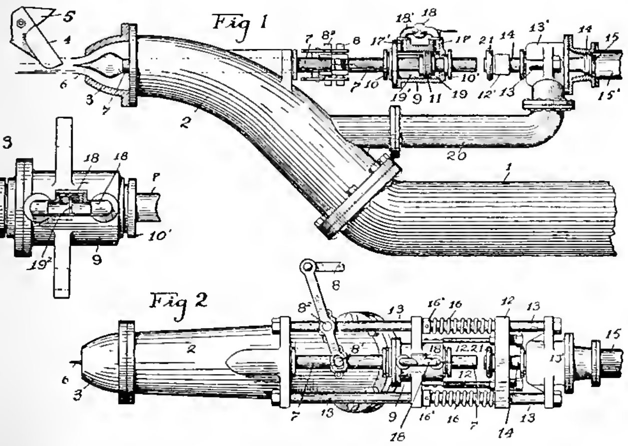
The counterbalanced stream deflector is shown in Patent Office drawing No. 853,787 herewith. The automatic water economy needle nozzle is shown in Patent Office drawing No. 993,064, and the automatic form of by-pass nozzle is shown in Patent Office drawing No. 853,786.



Automatic Water Economy Needle Nozzle.

In installations representing a considerable amount of power under a high water pressure, the problem of accurate regulation with maximum water economy demands, I believe, the introduction of two generic principles. The quick shifting of energy off or on to the wheel as explained above is absolutely essential. Equally important with this is that the water column shall be retarded at a very slow rate. This I believe imposes the necessity of two co-acting devices, one that will take care of the quick reduction of energy from the buckets of the water wheel and the other that will slowly thereafter retard the water column until just sufficient water is flowing to give the energy output being demanded from the wheel, and the co-action of these two devices must, when more energy is demanded from the wheel, be such that the needle or other water supply regulating device will open at a very rapid rate. In other words, if the needle is in a more or less closed position, and an

increased load comes upon our wheel, we will open the needle quickly to catch the load, and the automatic nozzle (Patent Office drawing No. 993,064) is designed to accomplish this purpose. If the load goes off, e. g., the circuit breaker opening, or is reduced, the stream deflector will come instantly into the stream, and when any water is being deflected by this stream deflector, the needle will slowly close at a rate under the control of the station operator and predetermined and fixed once for all, and at a rate which will take into account the length of the pipe line, head and safety factor of the pipe, so that the pressure rise cannot exceed this predetermined amount. A number of these automatic nozzles



Bypass Needle Nozzle.

are in successful operation and have been thoroughly proved out in practice, one of them, for over four years with a head of 1,060 feet, and a pipe line of 6,000 feet, the pressure rise being less than 5 per cent. The governor makes its stroke in one and a half seconds from full off to full on or from full on to full off.

Now this apparatus will accomplish results that I do not believe can be accomplished with the by-pass form of nozzle, and will secure more accurate speed regulation and with much greater pipe safety. It is being installed by the Sierras Construction Company, after an extensive experience with both forms. This is in their new large plant for supplying the Los Angeles district over the longest transmission line in the world. I merely mention it tonight as a further step, that Mr. Galloway did not bring out.

The needle nozzle is a very old device. The first that I am familiar with was put in in the old Con. Virginia shaft in 1888; four of them were built at that time, and operated under some 1,600 head or more very successfully.

As regards lapwelded pipe, I differ with Mr. Galloway. I believe it will be found on investigation that lapwelded pipes are highly successful where they are properly designed and built, and this of course applies to all mechanical apparatus. If it is not properly designed and built, you will not get good results from it; and you cannot buy that kind of pipe indiscriminately any more than you can buy riveted pipe indiscriminately. Mr. Galloway has mentioned some riveted pipes that are very old, and probably we would find that safety factors were used on those old miners' pipes of not more than two or three. I have seen a good many broken riveted pipes. I am not an enemy of riveted pipes; neither am I a staunch advocate of lapwelded pipes, but I believe that each pipe has its particular field, and there are many cases where lapwelded pipe will be found to be safer, more economical as a conduit, to say nothing of lower first cost. The Big Creek plants are putting in lapwelded pipes for 1,680 feet in one station and 1,960 feet in the other station. The pipes at the bottom of the hill in the power house will be 24 inches up to each nozzle; will have a thickness of 1.42 inches lapwelded longitudinal joints with flanges welded on. I have in mind a rather disastrous experience over in Colorado recently with a plant in which a riveted pipe was used under high pressure. There is a point, a dividing line, below which I think it will be found very much more advantageous to use lapwelded pipe. At Big Creek that point has been determined to be quite a long way up the hill; in fact, they are going to commence with 42-inch pipe, three-eighths of an inch thick as lapweld, with double bump joints and go down the hill to a flanged line under the higher pressure.

It might be interesting for you to know how this pipe is made. The sheet is rolled up just as the sheet for a

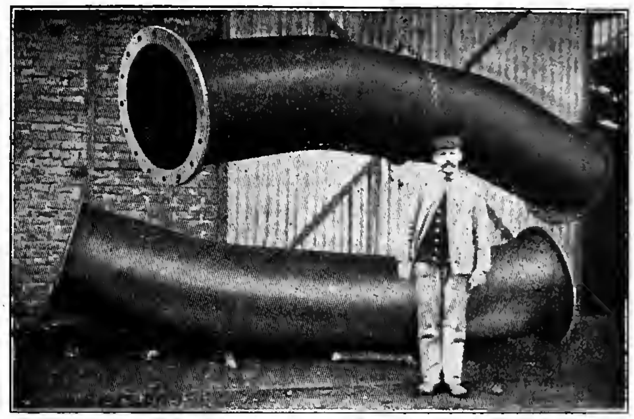


Fig. 1. One of the Special Elbows of the Lighter Material.

riveted pipe would be rolled up; then it is welded together longitudinally with a welding piece between the bevel edges

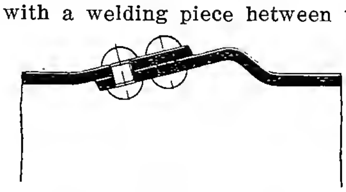


Fig. 2. Double Riveted, Double Hump Joint.

of the plate making a butt weld. The flange in the first place is rolled up like a locomotive tire, a piece is set in between the welded pipe and flange and welded down, then it is all

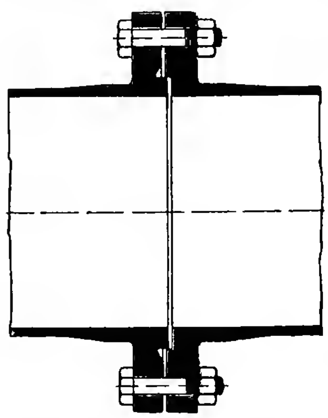


Fig. 3. Welded on Flanges and Form of Joint on the Straight Pipe.

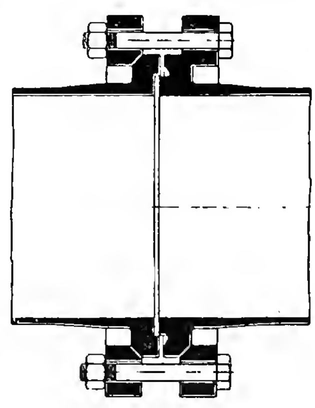


Fig. 4. Loose Flanges and Welded on Borders Used on Specials and Elbows.

put in a lathe and finished off, so you have a finished machine job on the ends of the pipe. The pipe will be made up complete and put together, every rivet hole reamed and every piece stamped where the sections go together, so it will come together just like a finished machine. They use water gas for the welding process and the large and light thicknesses are hand welded, and the intermediate thicknesses are machine welded. Each section will be fully tested in the works to a pressure considerably above the static

pressure when in place, and the elbows, wyes and specials will all be of lapwelded material, no cast steel iron or bronze fittings being used.

J. Homberger: Mr. Galloway stated that he had only five days to prepare this paper, but I have received his manuscript so late that I have had only about five minutes to prepare a discussion. Before I go to water wheels I want to refer to some other points. In speaking of flumes and ditches, Mr. Galloway mentioned that many of the existing hydroelectric plants had incorporated into their systems the ditches and flumes already in existence. In a great many instances it was an unfortunate thing that they did so. The slope allowed by the old miners, because they wanted to make the ditch small to save expense, was, as a rule, very much greater than should be allowed for power plants; I have had some cases where I recommended people that had purchased rights from old mining ditch companies to abandon the existing ditch and make an entirely new one with slighter grade—making a more economical installation. It would cost more money, but give a higher head and more power.

On flumes, Mr. Galloway says the flume is a temporary expedient, and as timber grows more costly will disappear. I suppose Mr. Galloway meant the wooden flume is a temporary expedient. No mention was made of steel flumes and concrete flumes which have been recently used extensively, and I think in some cases are very desirable.

Under the heading, "Pipes," Mr. Galloway gives the ratio between head and length of conduit. I believe this might be misunderstood. When you said the ratio is 2.32, and so forth, does not this include the canal?

J. D. Galloway: The ratio given expresses the relation between the head or drop and the length of conduit which brings the water to the pipe line; the flumes or ditches. It is a rough statement of the grade and the stream—the conduit as compared with the total drop.

H. Homberger: Mr. Henry has already spoken about welded vs. riveted pipe. Even where either may be used, I am a strong advocate of welded pipe. I made a special trip to Germany six years ago and visited the six largest plants then operating, to see how such pipe was made. One of the most interesting points is that these people will test with a specified pressure every length of pipe before it leaves the shop. This is not done with a riveted pipe. One case where I specified the pipes for a plant that was built in India I had the makers of riveted pipe put in an additional price for testing each length, and the cost of doing this testing was entirely out of the way. I think it was $25 per section of pipe. The people making welded pipe are equipped to do this testing, and do it as a matter of course, without extra charge.

Arthur Adams' formula for the most economical size pipe has been touched upon. I believe this was calculated for water works practice, where conditions are somewhat different from power-plant practice. The question of size of pipe and loss of head is an entirely economical or financial one, simply comparing how much the power is worth which you waste by making your pipe smaller and sacrificing more head.

To the same category belongs the question as to whether pipes should be designed for peak load demands or average load demands. Of course, the load factor is an important item in that; I have visited one plant in California where the pipe line had been designed apparently for a very low load factor; and the condition was such that when the gates are fully opened under a peak load, as they should be, the output is considerably less than when the gates are partially opened. The history of most hydro-electric plants has been that under peak load all units have to be loaded to utmost capacity.

Under "Gate Valves" Mr. Galloway states they should be of cast steel. I think that cannot be generalized. The size of the gate valve has a great deal to do with that, not only the head. You may use cast iron under very high head and it will give very satisfactory service, providing it is a good quality of cast iron, and not the cast iron which Mr. Galloway mentioned, where an old bolt head was found in the disk that had not melted. This was apparently largely made of scrap steel. It should be good material. I should like to know if that gate valve at Bishop, which was mentioned later in the paper, which broke under 1100 feet head, was cast iron or steel?

J. D. Galloway: It was cast iron.

H. Homberger: That is rather a high head for a big size valve to be made of cast iron. Mr. Henry has already dwelt on the by-pass nozzle. Before coming to that I will refer to another point. The impulse wheel is attributed to California. I do not think that is quite true. In 1742 a book was printed showing its use in the old Dauphinee wheel.

The deflecting nozzle I have never been much in favor of. When I was engaged in the design of the first two De Sabla wheels in 1902, deflecting nozzles had been specified, and I suggested at that time that they had some undesirable features, for instance, the packing; they are not economical because the entire saving of water depends on the carefulness of the attendants, whether they will actually move the needle when the nozzle deflects. As you have seen in the picture of the De Sabla Powerhouse, frequently all the jets go out of the powerhouse into the tailrace at full swing. I suggested at that time the use of a synchronons by-pass arrangement; such had been used in connection with turbines in Europe long ago—I think several years before they were used in the Nexaca plant that Mr. Henry mentioned. The Kubel plant, in Switzerland, has turbines with synchronous by-pass directly operated by the governor.

G. J. Henry, Jr.: That is correct, except they are not quite the same thing as the by-pass nozzle. They are synchronously operated devices, separate and distinct from nozzles.

H. Homberger: I simply wanted to say that this idea had been used in turbines.

Mention is made of the number of nozzles to one wheel. Mr. Galloway says: "As more power was required two and three nozzles were placed on one wheel. This was about the limit of the number of nozzles." If I remember correctly the Nexaca plant has four nozzles to the wheel.

Multiplicity of nozzles on one runner does not tend to good efficiency. A single nozzle wheel is more efficient than a two-nozzle wheel, and so on. I had an opportunity to test a plant years ago, where there are two machines absolutely identical in general design, except one has double the output of the other. One machine is operated with single nozzles and the other with duplex nozzles. I found a difference of about five per cent in efficiency practically all over the line in favor of the single nozzle machine.

In the early days of the tangential water wheel construction people were afraid of large jets. When the first Electra wheels were built it was decided to put two wheels alongside of each other, and they had three-inch jets. In the De Sabla plant, built much later than Electra, the first two machines are of the same output, but have single jets, and I suppose the efficiency is at least as good. There is no question but that a machine with two runners and two nozzles and so forth is an unnecessary complication if you can get the same result with one.

Mr. Galloway says that 6½ inches is the largest jet diameter. The "South Power-House" of the Northern California Power Company, I believe, has 9¼-inch jets, and that has been running now for five years.

J. D. Galloway: What is the size of the unit?

H. Homberger: Three thousand six hundred kilowatts.

J. D. Galloway: When I used the word, "largest," I meant the jet operating the same amount of power output at the wheel. I did not mean the actual diameter.

H. Homberger: The machines for the Los Angeles aqueduct are equipped with 14,000 h.p. in two wheels, each

with an 8½-inch jet. I discussed with Mr. Galloway some time ago the question of the advantage of having two wheels on one machine; he referred to a test made by Mr. Baum which indicated a higher efficiency for a two-wheel unit when each wheel carried half the load, than when one wheel carried the full load. Tangential wheels like Francis turbines are usually designed to give highest efficiency at a certain point, which point is not the maximum output of the machine. It is generally at three-quarters of the maximum the machine will carry. Now if you have a machine that has two wheels, as happened with the wheel built in 1904 for Electra—an extraordinary case—where each wheel has the full overload capacity of the generator, and you run both jets simultaneously, and run at or near the most efficient point, naturally you get a higher efficiency than you would get if you run one wheel at maximum output. I do not believe that the size of the jet has anything to do with the efficiency; that, is if I understood correctly what Mr. Galloway meant. I may have misunderstood him. If the proportion between the size of the bucket and the jet is proper there are no technical limits to that.

Geo. J. Henry, Jr.: That is my understanding within certain limitations.

H. Homberger: We have reached 10-inch jets, I think, in estimates—I think even 11-inch jets.

With regard to the question of the border line where impulse wheels and turbines clash, or are supposed to clash, it is simply a question of the quantity of water that has to be handled. The head has really nothing to do with it. If the quantity of water is sufficiently great, you may go to a very much higher head than at Centerville with Francis turbines and still get good efficiency. The turning speed conditions have very much to do with that. An impulse wheel might call for too big a generator. On the other hand, if you go too high a head with the Francis turbine and want a slow speed for the sake of the electrical end of the unit, your passages in the turbine runner will become so small that they will wear out quickly and may easily become clogged. Then the advantage is again on the side of the impulse wheel. Furthermore, there are cases where the water is very bad. If there is a lot of detritus coming in the water and cannot be kept out, the impulse wheel will suffer less than the turbine.

Regarding the 36,000 h.p. wheel proposed for the Big Bend power plant; Mr. Galloway says it was unfortunate that the Easterners were too timid to try it. The size of the unit is largely governed by operating conditions and load conditions, and by the possibility of loss of income by shutdown of the machine. Now if you have a power plant with, say, four units of 25,000 kilowatts each, and one of those units goes out for some reason or other, it would be very much more serious to the power company than if they had eight units of 12,500 each, and lost one. The question of loss of income in case of a shut-down has probably more to do with it than anything else.

Comparing the efficiency between turbines and impulse wheels, Mr. Galloway states that the efficiency of large units of turbines is between 87 and 90 per cent, and impulse wheels between 78 and 82 per cent. My personal experience in that matter from tests I have made, and a great many reports of tests I have seen, is, that the turbine efficiencies are given a little bit too high and the impulse wheel efficiency too low. They come very close together. I do not think the difference is so great.

The Chairman: Mr. S. L. Berry has had considerable experience in the design of water wheels and may be able to add some information.

S. L. Berry: In connection with this very interesting and instructive paper on "Hydroelectric Development," by Mr. Galloway, it might be well to add to the historical feature the fact that governor operated by-pass valves were used on this Coast as early as 1896 in conjunction with Girard water wheels. The Sessions-Van Emon shaft governor used at that time was so far ahead of water wheel governor practice that some unexpected difficulties were encountered on account of the severe water hammer produced by the rapid action of the mechanism. This was completely overcome by the use of large plug valves moved by the governor in inverse direction to the nozzles which were of rectangular form and made to contract by moving one wall. This device was first installed on a small wheel used on the American river, and was later utilized in a plant on the Kern river near Bakersfield. The Girard wheels did not prove successful but the governing was a distinct advance over previous practice.

Mr. Chairman: Mr. Cory, can you contribute anything to the discussion this evening?

C. L. Cory: I can only express my great appreciation to Mr. Galloway for the delightful way in which he has sketched the development of the hydroelectric plants on the Pacific Coast. As I listened to him read from his paper, and saw some of the pictures on the screen, I could not help but think of the men who had to do with the development of this great industry, not only in California and on the Pacific Coast but in America.

Some of us today, perhaps, looking at these plants may, unless we are rather thoughtful, conclude perhaps that things were not done as economically, or units chosen of the proper magnitude compared with that which exists today; but if you will bear in mind that these old miners' ditches were found here, and that the enterprise of generating electricity from water power and transmitting it and finding a market for it was a hazardous one, especially in those days, we can appreciate why these plants that were built, as Mr. Galloway has said, during the past twenty years are not exactly the type of plants that are being built today. I cannot refrain from mentioning a few names, and these names are not all the names of engineers. It wasn't an easy thing in 1892, and even as late as 1901 and 1902, to get the money necessary to build these plants; and as I looked at the large Electra plant I could not help remembering the work not of the engineer, but the enthusiasm and imagination of Prince Poniatowsky,—the detailed work of Mr. Eckart. Then again I thought of the fact that this great engine of usefulness, the hydroelectric plant, has been made up by dovetailing the work of a great many people, and it is not difficult to place certain laurels in certain places. For a long time we did not know very much about the velocity of water in various kinds of conduits. I remember very well it was Jimmy Wise who first studied most critically the uniform lines of velocity in ditches. So I might mention a number of other men—Mr. Martin, Mr. De Sabla, and many engineers of the manufacturing companies, both hydraulic and electric; and the story, to be complete, must conclude with the statement that resourcefulness and consistent effort are what has brought all these things about; the co-operation of many men occupying different relations.

The Chairman: Is there any further discussion of this paper?

Question: Are there any electrical engineers present who have any experience in the operation of plants where nozzles have been installed provided with deflectors such as Mr. Henry has described to us? I would like to know if they have had any trouble with the alternators due to the rapid throwing on or off the jet? It may be very desirable to eliminate surges in the pipe line, but if it results in creating surges in the transmission line we are not very much better off. To my mind it looks far more desirable from the transmission line point of view to have a regulation where the jet was gradually thrown off, and I would like to hear if any engineer has any experience in that?

C. L. Cory: I have had quite a little experience with generators of that type, that is, with the deflectors, and I have

never seen a single instance where there was any difficulty whatsoever from taking all of the load off the generators installed by throwing those deflectors in, even where the generators were operating in parallel with a great many others. I do not believe that the difficulty is to be compared at all with the difficulty of operating generators together when driving through a reciprocating engine.

The Chairman: Mr. Hanscom, can you contribute regarding Colorado practice as contrasted with what Mr. Galloway has brought out?

P. T. Hanscom: I might mention the Boulder Development of the Central Colorado Power Company as representing perhaps one of the most modern designs of tangential wheels. Two wheels are installed, each having a capacity of 11,000 h.p. The speed is 400 revolutions per minute, and the static head is 1,870 feet. The style of nozzle and the design of buckets are a little different from former practice. The nozzle is hung on a trunnion, and water is taken in through a bifurcated pipe to the nozzle rather than the old style ball socket joint with packing. This form of construction gives a stuffing box joint, which is more reliable than the strap packing or what is ordinarily used on the socket joint. The buckets are all cast together in one piece.

Mr. Galloway spoke of the twilight zone in choice between Francis turbines and tangential wheels. Different engineers have considered this from various extremes, perhaps one of which is the plant in British Columbia which he mentioned, where four impulse wheels were attached to a single unit. It seems to me that such a large number of wheels, or two or three nozzles to a single wheel, results in quite a complicated equipment, and ordinarily works out at very much greater cost than the Francis turbine construction. In the British Columbia plant I think the ratio of the bids mentioned by Mr. Henry to me was something like $43,000 for the tangential wheels against $29,000 for the Francis turbine.

A case in Mexico with which I had to do showed a ratio, considering both generator and wheels installed, of about two to one, that is, after looking into the problem of 6,000 h.p. units under an operating head of 670 feet—which I believe to be a higher head than had been adapted to Francis Turbines before that date—we found that when, taking into consideration the speed of the generators, the thirty-five-mile haul and the additional tonnage, it would cost us just about twice the amount of money to install tangential wheels that it would to install Francis turbines; and in that case we adopted the Francis turbines operating at 514 revolutions per minute.

It seems to me that the adoption of turbines for increasing heads will continue, and it won't be long before we will have turbines operating at, say, 1,000 feet head, providing the size of unit is in proportion so that a proper diameter of runners can be used. A unit comparable to a 1,000 foot head would probably be 12,000 or 15,000 h. p. or greater. The larger the unit for the higher head, the more favorable the conditions.

J. D. Galloway: In regard to the tests of the two units at Electra to which Mr. Homberger has called attention, it may be stated that these units are rated at 5,000 kw., being of the same design as the one originally purchased for De Sabla. It was intended to be a 4,000 kw. unit, but when placed in operation it developed that it would give 5,000 kw. without excessive heating, and since that time has been rated at that amount. Under tests this machine has given over 6,000 kw. It is well known that in designing a water wheel to operate such a machine the wheel is designed to have its most efficient point at the normal rating of the generator. This is true in the case of the wheels at Electra. They were supposed to be so designed that they were most efficient at 5,000 kw., and therefore had an overload capacity. Therefore, in the comparative test of which I spoke in my paper, the comparison was made not between wheels partially loaded as compared to those fully loaded, but rather the test was made at points somewhere near the most efficient condition of the wheels. For this reason the tests were comparative, and would indicate that the generator with two wheels was to a certain extent more efficient than the one with one wheel.

I was not present at those tests, but Mr. Baum told me in a general way that the tests all proved that the double wheel was probably a better machine.

In speaking of the De Sabla wheel, the jet was 6½ in. in diameter, and it was my intention to convey the idea that this jet was the highest power jet in use. It has been developed that larger sized jets are in use, diameter considered; but only comparative tests will ever tell where the most efficient diameter of jet lies. A number of other considerations relate to this subject, such as the speed of the generator. In obtaining data upon a 10,000 kw. generator it developed that a speed of 360 r.p.m. was about right.

Again, only a certain sized diameter of wheel can be shipped. For these reasons judgment must govern in deciding the size of the jet which may be used.

Referring to some points mentioned by Mr. Homberger. He is in error regarding the Necaxa wheels. They have two jets to one wheel. A description is given in the June, 1907 volume Transactions of the American Society of Civil Engineers.

The formula given by Mr. Arthur Adams for the economical design of pipes was not for water works pipes where loss of head cannot be translated into a value of power lost. Mr. Adams' formula, as given in the Transactions of the American Society of Civil Engineers, was worked out for power plant pipes lines. It is only an expression for that economical basis upon which all parts of a power plant can be designed, such as the transmission line, provided certain factors can be known. It is the difficulty in making the correct assumptions that makes judgment in selecting the size of pipe still the controlling factor.

Referring again to the proposed 36,000 h.p. turbine at Big Bend, Mr. Homberger says that loss of income in case of shutdown was probably the reason for rejection of the large unit. This was not the case. The plant now has four 18,000 h.p. units and a detailed study shows a sufficient amount of flexibility of the plant under load conditions as they are. It must be conceded that Mr. Hanscom understood these conditions when he suggested the large unit.

One word more regarding the question of pipes. The contract at Big Bend is not yet awarded, and pressure is being brought to bear to have different types of pipe adopted. The engineers of the Big Creek plant may feel confident that the lapwelded pipes are the best. All that I can say is that their troubles are ahead of them. I am speaking from the experience gained from troubles that are behind us.

Some criticism has been offered regarding the dates that are given in the paper. I would say that practically all of my historical information has been obtained from the pages of the Journal of Electricity, Power and Gas.

Geo. J. Henry, Jr.: I want to apologize to Mr. Galloway for not making myself clear in connection with the deflector that I sketched on the board. I did not for a moment intend to insinuate that he had not given me credit for the deflector; but what I was trying to show was not the deflector alone, but the deflector in connection with the automatic moving needle to effect water economy and accurate speed regulation. The device that I have shown on the board has been in operation I think now for over three years. With a 6,000-foot pipe line and a 1000-foot head, they were able to greatly increase the output of their plant, and maintained accurate speed regulation while economizing with water at the wheel with this device.

I have not tested a by-pass nozzle under identical conditions; but I have tested a by-pass nozzle under 360-foot head with a 2,600-foot pipe line, in which case the pressure rise was 15 per cent with one-half the load thrown off, as against not to exceed 5 per cent with the entire load off with the automatic nozzle mentioned under the much more severe conditions; and it was to bring out what I believe to be a

much more perfect piece of apparatus that I mentioned the deflector in connection with the automatic needle nozzle.

I would like to add a word or two to Mr. Hanscom's remarks in connection with the use of a tangential wheel equipment versus the Francis turbine.

I understood him to make the statement that the plant that Mr. Galloway mentioned—I don't remember Mr. Galloway mentioning the name, but Mr. Hanscom and I recognized the picture that was thrown on the screen, which showed four wheels on one shaft with 5,000 kw. generator, each of those wheels equipped with a double nozzle, meaning eight jets on four tangential wheels to drive one generator; and Mr. Hanscom stated that the cost of that equipment in comparison with a high-class Francis turbine was as about $29,000 for the turbine against $43,000 or $44,000 for the tangential wheel. Those figures I believe are correct. That is simply the first cost of the equipment. Let me add in that particular unit which is operating under 360-foot head at the plant of the Vancouver Power Company, the cost of the foundations and other incidental expenses were greatly to the disadvantage of the tangential wheel, largely increasing its installation cost over what it would have been for a turbine. In addition to that there is about 3 per cent of head lost; and further, there is a disadvantage of, I think I am conservative when I say, not less than 12½ per cent loss in efficiency when that unit is running the generator at normal load.

Those figures I give advisedly. I have investigated that particular case very thoroughly, and was concerned with the design of a good deal of their apparatus. I went up there and put on some automatic recording instruments and tested it thoroughly; and I know in that particular case the loss in first cost to the company was not less than $25,000 to $30,000 on each one of such units that they have put in, and 15 per cent of the horsepower capacity of the water is being lost continuously, compared to what could have been obtained and is being obtained in other plants with Francis turbines.

These power companies when making money and setting aside considerable surplus every year may not notice a thing like that; but the time will come when they will notice it, and they will have to sweep aside prejudices in favor of some one design and give consideration to other designs on more logical engineering lines if they want to get the best results from money invested.

Errata Note.—In the original paper by Mr. Galloway as published in this Journal of October 12, 1912, the sixth line from the top in the second column of Page 314 should read "thick at the bottom."

THE 1912 BOSTON ELECTRIC SHOW.

The 1912 Boston Electric Show, which is now being held, is attracting great attention, being one of the most elaborate and comprehensive electrified trade exhibits ever held. An elaborate street illumination has been prepared along the principal streets leading to the Mechanics' Building, whose exterior is illuminated with 30,000 incandescent lamps.

Beautiful interior effects have been secured by the use of fireproofed decorative materials, and by the lavish application of the brushes and paints of talented and high-priced artists. Grand Hall is typical of a substantial German village, the effect being borne out by the gallery construction and designs of the decorations for the exhibit booths on the main floor. The Electric Vehicle Section bears out the illusion of an open park, with its boulevards, trees, and beautiful park lighting effects. Machinery Hall bears out the illusion of a large factory, with its brick walls, open windows and ample illumination, characteristic of the electrically equipped manufacturing establishment. The galleries and broad halls of the second floor conform in their decorations to the character of the exhibits; the same is true of the large spaces in the basement.

In the basement is a first-class, completely equipped electric garage. Here the demonstration cars of the exhibitors will be kept, and provision has also been made for garaging the business cars the exhibitors are using.

A. I. E. E. DIRECTORS' MEETING.

The regular monthly meeting of the Board of Directors of the American Institute of Electrical Engineers was held in New York on Friday, October 11, 1912. A number of important matters were settled, including the adoption of a bylaw that the appropriation of Institute funds for the meeting expenses shall not exceed a fund determined as follows:

(a) Fifty dollars for each Section independently of the number of members in the Section.

(b) One dollar and twenty-five cents for each Institute member residing within the territory of the Section at the beginning of the administrative year, August 1.

A resolution was adopted placing in the hands of the Secretary a fund sufficiently large to enable him to pay promptly upon receipt the expense vouchers of the Section secretaries covering the expenses of Section meetings, subject to ratification or adjustment later by the Finance Committee. Heretofore there has been some delay in the payment of these accounts, owing to the plan of holding the vouchers until approved by the Finance Committee, which meets but once each month.

The directors adopted the recommendation of the Badge Committee that the present form of badges for associates and members remain unchanged and that the form of badge for the grade of Fellow be the same size and shape as the Members badge, and identical in design, including the lettering, the only difference being that the Fellows badge shall be the reverse of the Members badge in color; namely, shall be blue lettering on a gold background.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

October 15.

The Tujunga Water & Power Company, of Los Angeles County, applied for authority to issue $300,000 of bonds, the proceeds to be used for construction of dams and for further development of water.

October 16.

A decision was rendered granting permission to the Southern Counties Gas Company, operating in Los Angeles and Orange Counties, to issue bonds in a sum not to exceed $47,000 as soon as the company had met the terms imposed in its mortgage. The mortgage requires that its earnings must reach one and one-half times its bond interest before the new bonds may be issued.

Permission was granted to the Great Western Power Company to purchase the North Sacramento Light & Water Company for $9000 and to assume obligations.

A decision was rendered granting permission to the Burbank Electric Light & Power Company to exercise franchise rights for the sale of electricity in Burbank, and also to issue 20,000 shares of stock to be sold at $10 per share to finance the construction.

October 18.

A decision was rendered granting the Pacific Electric Railway Company permission to issue $5,285,000 of bonds. The bonds are to be used to retire underlying securities of the Los Angeles Interurban Railway Company in the amount of $2,537,000; the Los Angeles & Redondo Railway Company in the amount of $500,000; and the Los Angeles & Redondo Railway Company in the amount of $2,248,000.

The Mountain Power Company applied for a certificate of public convenience and necessity to construct an electric plant in Crescent City and to operate in Del Norte County.

DISCUSSION UPON "GAS ENGINEERING IN AMERICAN UNIVERSITIES."

The President: Gentlemen, we are indeed indebted to Professor Sibley for this valuable paper that he has read us and for the information contained therein. I would be pleased to hear from Mr. E. C. Jones on the subject, and an expression of his opinion.

E. C. Jones: Mr. President, and members of the Association, Professor Sibley's paper is splendid. For a time I wondered if we were making a mistake in disintegrating the engineering profession into gas engineering, electrical engineering, civil engineering, and so on, instead of devoting our attention to integrating and making more of the engineer, making the title of engineer one of honor and so building up the ground work and giving the man the fundamentals by his college course so that when he graduates as an engineer it would be a simple matter for him to turn for his vocation to any branch of engineering. Gas engineering, of course, is special. In the past and at present in England, the gas engineer practically inherited his position. It is passed from father to son. In the old country the boy is parcelled out to a gas engineer. His father pays so much a year for five years for the privilege of having his son associated with a gas engineer and picking up the crumbs from his table in the gas business. We, in this country, are more liberal. We take the boys into our business. I love the boys and I would like to devote the last years of my life to helping young men get ahead in the gas business. We have among us many young men, and I want to say that I firmly believe in Californians. I was born and raised in Boston and I have many reasons to be proud of it. But during the last twenty-one years I have become a Californian and I am prouder of that. I love California. I believe in California's ways of doing things. I like the breadth of mind and wholesale way of doing things by both heart and head, and I am going to root for California as long as I have a breath in my body. (Applause).

I believe that the gas engineer of the future who takes our California money for making our California gas should be a Californian. I do not believe in imported articles any more. I think that we have the material here. Our climatic conditions and everything tend to the making of men in California, and the rest depends on the boy himself. Let us look about and find the timber, the raw material, among the boys of California, and let it be understood that the gas men of the future must be Californians—boys born and reared in this state and educated in this state, and let us members of the Pacific Coast Gas Association make their paths smooth towards success. We obligated ourselves, when we dug down for a hundred dollars or so. But that is not the end of our obligation. We are asking young men to adopt a vocation as we think in all seriousness, but have we stopped to think what is to become of the young man after he has devoted four years of his life to the attainment of the fundamentals in the university, to vacation periods in the gas works getting the practical side of it or, in other words, finding out what he wants to know when he returns for his fifth year at the university? And after he has graduated, after he is turned out of the university upon the completion of his fifth year, what are we going to do with that boy? There our obligation begins. It is not with the spending of our money. That is easy. Money often gets a man into trouble. But we as members of the Pacific Coast Gas Association must foster these young men and keep them out of trouble. We are responsible for their future. Stop and figure it. It is a very serious matter. It may be your boy or mine. We are responsible for the future of the boys now who listen to our promises and spend five years of their lives at the university. We must provide for them. And as the gas business of today is becoming boiled down to a few syndicates, large corporations, which include large numbers of smaller works, and the whole business is in the hands of a few men, it must depend on those few men to pick up this work that Professor Sibley is going to do at the university, and carry it forward. Not that we should take these young men and immediately make gas men of them; not that we should take these young men and burden them with a degree which would be the greatest handicap for a young man to take into a gas works to learn the business,—but we should say to these boys, "We will provide places for you, if not as cadet engineers, then as storekeepers, as office clerks in one department or another of our business, so that when we get to the real need of a man, a man to handle industrial gas appliances, for instance, we do not have to go east, we do not have to go anywhere, but we have the man ready at hand." We are not going to build gas engineers to take charge of great undertakings in California alone, because there are so few of them. We are not so well equipped with great undertakings here as they are in the east. There are more gas works in the little state of New York—and you could hide New York in one of our counties in California and lose it—than there are on the whole Pacific Coast. These young men are going to grow up and take our places and we are obligated to foster them, care for them, and see that they have places.

In regard to the degree of gas engineer, if it should be decided that it is advisable to so further disintegrate engineering as to have a degree of gas engineer, then it should come after long experience in the gas business on the part of these young men, and it should be the reward of merit after having succeeded in business, demonstrating this success to the satisfaction of their professors at the university upon their return to receive the degree, and demonstrating it to the public by their good works. Then maybe it is fitting to give these young men a degree of gas engineer, but not for a moment should we think of cheapening that degree or of giving that degree to an old line gas man who has struggled up from nothing, fought his way into the gas business and has made a living out of it. He should not have the honorary degree of gas engineer. Let us begin with fresh timber. Let us build our gas engineers and then, if they deserve it, let us give them the degree of gas engineer. Let us keep it high toned; make them work for it; and after they have gotten it, let them feel that they have something, and that the degree has not been cheapened by giving it to E. C. Jones or L. P. Lowe or somebody else to start the ball rolling. Give it a value which the man will place above everything else in his possession. And, gentlemen, in closing—you will pardon me; this is very close to my heart. I love the boys. The boys in my employ—and I have had three good fellows out of the mechanical engineering department of the University of California since the last commencement at California, in the gas works. Those boys get along much better than my own boys. They get more from me. I am more sympathetic with them. I suggest books for their reading and I try to make their work lighter than I would with my own boy.

In closing, I want to offer you a motto for this work that we are undertaking—the education of gas engineers—and ask you to take it home with you and think it over: "The finest success in life is to help another attain something that we have missed." (Applause.)

The President: Professor Cory, would you like to say something further on this subject?

Professor C. L. Cory: Thank you. A very little. We do not for one moment expect you to think that this is final. It is not. And by the discussion which I insist that we desire—and those of us who are most interested—and I need not mention President Wheeler—who is interested in this matter as much as in anything else in the University—would like to carry back any criticism or modification. And let me tell you that while I have the proper consideration for the ability of my associates, I will not have it misunderstood but what I prize much more highly the ability of the men in this Association in this particular matter. (Applause.)

Jno. D. Kuster: There is one thing that occurred to me in

listening to this paper, and that was the idea that the student would be expected to make up his mind before he entered college what he was going to do. In the experience that I have had, I think that students do not know, or very few of them do, until they are probably half through the course, and I was wondering why a course could not be arranged to take up about the first two years of ordinary work and then to fix him in the special lines in the next two years.

Professor Robert Sibley: In the program that we have outlined, the first two years are identical with our courses for general engineering students, whether mining, chemical, civil, mechanical, or electrical engineering. This course as here represented is the same as the mechanical and electrical students have at present at the University for the first two years. They do not begin to specialize except to take a little more chemistry which they would otherwise have as an elective study. When the student comes back at the end of the Junior year, he must make up his mind finally at that time. At that time he will probably be in shape to know from experience what he wants to do.

Henry C. Keyes: I have listened to this paper with a lot more interest than I have to any paper that has been written or read before any Association in the last fourteen years that I have been a member, and I do not see where we have one particle of criticism. I think the thing does not need any criticism. I have a son who graduated from Harvard—took the chemical course—and I am willing to say that in Harvard they do not have the facilities that they have in the University of California. The paper read by Professor Sibley is the completest that I have ever listened to in my life, and I hope there will not be any criticism. It does not need any criticism. I hope that the suggestions he has made will be followed out by this Association. And, in any financial aid that is necessary to carry this thing out, I know you can consider our Association will stand its share.

L. P. Lowe: I would like to ask Prof. Sibley if it would not be helpful for the University to have an experimental gas plant.

Professor Robert Sibley: It would he helpful, but I think it would be better if the plant were situated at some works nearby, where it would be possible for the students to go to and from. We would not suffer from having it off the campus. One of the ideas I had about this student work was that the student might spend a good deal of time, not around Berkeley nor around Oakland, but down here in Los Angeles, in special investigations. There should be a very intimate relationship between this Association and the University. The Association should work in conjunction with it. Let us know what the problems are and we will put these investigators to work.

Jno. D. Kuster: We have on this matter a permanent committee on engineering degree, and it appeals to me that it would he fitting that we should pass some motion showing our approval of this course outlined here by Professor Sibley, and instructing our engineering committee to make such arrangements as will put it into effect. I therefore make that as a motion.

The President: You have heard the motion.

Professor Cory: One other thing I wish to say. The University of California has expressed itself and really has shown its co-operation financially in this matter. We have a big financial problem there. But as long as Mr. Britton is as keenly identified with the finances of the University as he is, being a member of that committee, and as long as President Wheeler is interested as he is, you can rest assured that the financial problem will be met. We have the money to get just such an equipment as Mr. Jones speaks of. A reference of this matter, for such action as may be needed in the future, to your committee will be very, very fine for us who are working at it at the University.

L. P. Lowe: As a member of that committee, and on behalf of my fellow members, I would like to say that it seems to me that the matter might very well be left in the hands of the professors of the University from now on. I am very sure I will he glad to render any aid that I can.

Professor Cory: You will be called upon. Don't worry.

E. P. Lowe: It seems to me that the thing to now do is to get to work. Speaking for the committee, we will give all the assistance we can, but we are now "passing the buck." If the University will tell us what they wish us to do, it will be far better than for an inefficient committee of the Association to tell the University what it thinks it should do.

E. C. Jones: I believe that it is most important for us now to make up our minds to help in every way we can. But it is more important that we should not hinder these gentlemen. It is possible for us individually and as an Association to hinder them in their work. I believe we should have nothing to say about the selection of the timber. That will come naturally to the University of California, and the process of making a gas engineer will be by the process of elimination. If a man is not fitted to be a gas engineer, we will find it out and he will find it out after he has entered our employ. But let us help and not hinder. I do not believe we should place any handicap in the way of these gentlemen who are devoting themselves to this task.

F. H. Leach Jr.: May I ask if special lectures which are given in connection with the course will be open to special students? In other words, would any of the employes of the companies or members of this Association who are past that point where they could enter college or, perhaps, are not fitted to take up a college course, have the benefit of special lectures which may be given in the course?

Professor C. L. Cory: I can answer that by saying, Mr. President, that at the University not only are we glad to have anyone come in to any course at any time—because that is the way in which the work is done—as long as we have room for them, but I can assure you if anyone desires to go into any of the courses there, either directly as indicated here or indirectly as related to this work, the University will be most delighted to receive him. And, further, one point which I think has not been touched upon. A great many of you gentlemen here will not have the pleasure of being in the audience in the University, but you will find yourselves in the position of instructors at various times when you can spare us an hour or two to come over and give a real lecture by men who have really had experience, rather than to have students listen to us who have only had the opportunity to learn out of books.

Jno. D. Kuster: My motion was to put the stamp of approval on this paper and instruct our permanent committee on Gas Engineering Degree to work in harmony with the professors and faculty in putting this course immediately into effect.

Mr. Kuster's motion is thereupon put and unanimously carried.

NATIONAL JOVIAN CONVENTION.

As announced in these columns last week Frank E. Watts was elected Jupiter at the tenth annual convention of the Rejuvenated Sons of Jove at Pittsburgh, October 14-16. The other officers elected were: Mars, W. D. Shaler; Neptune, L. M. Cory; Pluto, A. W. Woodville; Hercules, H. A. Hart; Apollo, S. S. Montgomery; Avrenim, W. H. Vilett; Mercury, Eli C. Bennett; Vulcan, Chas. L. Martin.

On Tuesday there was a big parade, which was elaborately featured in the Pittsburgh newspapers. Particular credit and thanks is due to the electrical men of Pittsburgh for their cordial hospitality to all visitors.

With regards to holding the annual convention in San Francisco at the time of the Panama-Pacific Exposition in 1915, it was shown that the convention is always held at the home town of the Jupiter. Consequently, it will be necessary for a San Francisco man to be elected to this position at the 1914 meeting if the convention is to be hald at San Francisco in 1915.

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

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CONTENTS

The Stability of Hydroelectric Securities

During the past week public attention has again been directed to the stability and desirability of Western hydroelectric securities. The immediate occasion has been the emphatic denial by the officials of the Great Western Power Company of certain rumors that have been circulated to account for the cessation of work at the Big Meadows dam with the beginning of winter. However, regrettable may have been the effect of such stories on the stocks and bonds of this company, the widespread publicity of certain little known facts should be of great benefit to the industry in general.

Most significant is the statement that there is no hydroelectric security on the market today which has even been threatened with default. Considering the extreme youth of this important industry and the many ills to which childhood is heir, it augurs well for the early maturity of this class of investments. The day seems not far distant when hydroelectric issues will be on a par with those of the great railroads.

The Municipal Telephone

The city council of Seattle has recently appropriated a substantial fund for the use of the department of public utilities. This money is set aside to procure data necessary for the consideration of the construction and installation of a municipal telephone system. Other cities have in desperation, born of repeated inefficient service from the existing utility, under taken similar campaigns. Indeed, San Francisco and the bay region represent today such a state of affairs. Relief from poor service will not come so much from the competition of an installation built by the municipality as the necessary reduplication of equipment is costly. By forcing the utility itself, however, to give good and adequate service, the municipality takes advantage of its god-given rights. It is surprising that the citizens of San Francisco have now allowed many months to pass without bringing to a crucial test the illegal purchasing of the independent company's properties and franchises last winter. The inefficient service now administered since this removal of the former competitor, is indeed flagrantly apparent on all sides.

Growth of Foreign Electric Trade

The continued increase in demand for American-made electrical apparatus, especially among those countries bordering on the Pacific, is making itself felt in the commerce of the great nations of the world. A few years back Germany, for instance, practically corralled the entire import electrical supply for Chile, where large hydroelectric installations were being made. Today, in this South American republic, American manufacturers are getting a strong foothold, much to the discomfiture of the subjects of the Kaiser. This is only one instance of many that may be cited. So strongly is American influence being felt that the statistics recently issued by the British Foreign Office clearly indicate this trend in affairs electrical. In the year

1911, Germany exported a total valuation in electrical goods of $52,558,000, thus indicating no gain over 1910. Great Britain exported a total of $22,689,000, as opposed to $28,246,000 in 1910—a heavy loss in prestige. The United States on the other hand exported $19,329,000 in 1911 as opposed to $16,547,300 in 1910—an increase of about 20 per cent. American enterprise is thus shown to be firmly established in foreign quarters.

The increasing friendly relationship of western engineers and interests with the countries bordering on the Pacific will immensely heighten this foothold in the immediate future.

International Gas Congress

The announcement that E. C. Jones, official delegate from the Pacific Coast Gas Association, and the Panama-Pacific Exposition Company, has secured the hearty and enthusiastic support of the American Gas Institute for the holding of an international gas congress is indeed a subject for congratulation. The event is scheduled for September of 1915, at San Francisco, which is the month decided upon for the holding of the international electrical congress in that same city.

The meeting place is indeed appropriate. California, the cradle of the hydroelectric industry, together with its sister commonwealths, may well boast, not alone 70 per cent of possible potential water powers in the United States, but in actual development of the art, she may boast the highest standard of progress. Then, too, the continued increase in production and in highly scientific application of petroleum upon the Pacific Coast, demands a fair consideration as a near world leader in crude oil application and especially in one highly technical branch, that of oil gas manufacture.

Hydroelectric Design

A comprehensive symposium among men acquainted with the development of the hydroelectric art and design has long been a deep-felt need. The discussion found on another page of this issue, brought out by the recent paper of J. D. Galloway before the San Francisco Section of the American Institute of Electrical Engineers, is indeed important. Here are men who have made the West known the world over as a land where hydroelectric design reaches its highest development; men who have been the leading factors in bringing the hydraulic giant from the uncertain and inefficient tool of the early miner to the faithful, highly efficient impulse nozzle of today. Again, in this group are men that came upon mountain canyons laden with the steep-falling ditches and flumes of the "forty-niner" and have converted them into concrete lined canals and neatly cemented tunnels of present day practice. Add, then, to these two groups, the third who have assembled the equipment of the power house and wrought its efficient trim design and the symposium is complete.

It has been difficult in the past to find a comprehensive treatise on power plant design. The engineer who knows is, as a rule, a busy man. Such a man has scant time to put in writing what is taking place within his thinking consciousness. The contributions thus far, though others could contribute interestingly and profitably, nevertheless, present a working basis. They are in fact agreeable to the ancient Latin motto—non in summa sed in via—"not in the summit but on the way." Other contributors will certainly be welcomed by the editorial force of this journal and by the engineering fraternity at large.

One-Man Prepayment Car

Until the traveller has visited Montana and spent a winter among the beautiful mountain valleys of the Western portion of that great commonwealth he is liable to have, a mental picture of the climate there to be found wholly at variance with the true conditions. Western Montana, hemmed in by high mountains on all sides, thus affording to its fertile valleys a complete protection from the cold blasts of the Dakotas and the open portions of Canada to the north, presents features of seasonal beauty and wholesome ruggedness of climate in delightful proportions not to be found even in far-famed California, or in other portions of the Pacific Northwest. Such natural blessings, dawning upon the citizens of Missoula in 1900, caused a wide-spread realization of her importance to be crystallized into municipal growth with the result of a trebling in population by 1910. Along with this growth in population and in civic pride arose the yearning desire for an electric street railway. Viewed from every economic point, however, the enterprise could not be counted upon as a profitable one for years to come. Under the most favorable calculations, the utmost economy was seen to be necessary in operation of the proposed system if any return could be promised to the investor. The one-man prepayment car was decided upon as described elsewhere in this issue. Many were the forecastings as to the outcome. Today after three years of continuous operation the system stands as a monument of enterprise and ingenuity in this little city of Western civic pride.

The eminent humorist, Bob Burdette, once said that along a certain railroad crossing Indiana there were to be found ten universities and colleges and that there was an insane asylum situated at each end of the line. He ended by remarking that perhaps "the product of the means was equal to the product of the extremes." Be this as it may, the university student, due to his idealistic, and at the same time, "tom-foolery" make-up, is generally regarded as at least a fair test of the patience to transportation companies serving him. In Missoula, the railway system has three dead ends; one at the State University grounds, another at the U. S. Army post—Fort Missoula—and a third at one of the largest sawmill camps in the West. Any system serving the student, the common soldier and the lumber-jack, which after three years' operation returns a profitable ledger showing the handling of 2,500,000 patrons without a single serious accident, does indeed commend itself to the thoughtful consideration of other young and growing communities of the West.

PERSONALS.

R. C. Coffy has been appointed treasurer and auditor of the Tacoma Gas Company, replacing **R. F. Riseling**, resigned.

J. P. Downs, general superintendent of traffic of the Pacific Telephone and Telegraph Company, is at New York City on business.

H. A. Russell, sales manager for the General Electric Company at San Francisco, is on his way East to visit the factories at Schenectady and elsewhere.

Paul M. Goldrick, who was formerly connected with Fairbanks, Morse & Co., at Indianapolis, has taken a position in the San Francisco office of the Kellogg Switchboard and Supply Company.

Sidney Sprout, consulting engineer for the California-Oregon Power Company, returned during the week from the power site on the lower Klamath River, where a large dam is to be constructed.

Andrew N. Fox, advertising manager for the Benjamin Electric Company, and vice-president of the Chicago Advertising Association, is conducting a twenty weeks course in advertising for the Chicago Y. M. C. A.

R. B. Candage, formerly cashier of H. M. Byllesby & Company's Pacific Coast headquarters at Portland, Oregon, has been appointed auditor of the Western States Gas & Electric Company at Stockton, California, replacing **B. F. Wellington**, resigned.

E. B. Strong, president and general manager of this Journal, has been appointed Pacific Coast master of transportation for the 1913 convention of the National Electric Light Association, which will be held at Chicago probably during the first week of June.

P. H. Coolidge, general commercial superintendent of the Pacific Telephone and Telegraph Company, is at Los Angeles on business. **Charles F. Mason**, division commercial superintendent of the same company, with headquarters at Los Angeles, is a recent San Francisco visitor.

W. W. Briggs, assistant general sales manager of the Westinghouse Electric & Manufacturing Company, returned to San Francisco last Monday, after attending the sessions of the National Electric Railway Association at Chicago, and the annual Jovian Rejuvenation at Pittsburg.

Frank Hildreth of the Northern Idaho & Montana Power Company, Kalispell, Montana, has been appointed manager of the new business department of that company, succeeding **A. P. Tills**, who has gone to Eugene, Oregon, to assist Manager Jennings of the Oregon Power Company.

Geo. Dielman, manager of the new business department of the Tacoma Gas Company, has been appointed assistant manager of the Tacoma Gas Company, in charge of the Olympia plant. **H. H. Whiteside**, who has been temporarily filling the position at Olympia, has returned to the new business department at Tacoma.

E. C. Jones, gas engineer for the Pacific Gas & Electric Company, and delegate to the American Gas Institute from the Pacific Coast Gas Association, has secured the enthusiastic support of the American Gas Institute for an international gas congress during September of 1915 at the Panama-Pacific Exposition.

H. T. Edgar has been transferred from the management of the Seattle Division of the Puget Sound Traction, Light and Power Company to that of all the Stone & Webster properties at Houghton, Mich., Paducah, Ky., and the great hydroelectric plant being built at Keokuk, Iowa. His headquarters will be at Boston.

H. V. Carter, president of the Pacific States Electric Company, spent the past week in Sonoma and Mendocino Counties on the trade extension excursion tour of the San Francisco Chamber of Commerce. The various industries, such as the wine-making in Napa and Sonoma Counties, and the lumbering at Willits, were thoroughly investigated by the members of the party.

L. A. Somers has been made manager of the industrial and power department of the Pacific Coast district agency of the Westinghouse Electric & Manufacturing Company. This department has grown to be the most important employing about fifteen men. **W. P. L. Hommedieu**, of the same office, at San Francisco, will take charge of the railway and lighting department.

John Peirce, superintendent of the Mutual Telephone Company of Honolulu, passed through San Francisco during the week, en route from the Hawaiian Island to the Eastern States. An automatic telephone system is used in Honolulu, and Kellogg apparatus on the other islands of the group. The wireless telegraph business in the islands is controlled by this company. Mr. Peirce says that 42 per cent of his rural subscribers are Japanese.

TRADE NOTES.

H. Bittman, consulting engineer, White building, Seattle, who prepared the plans for the four transmission towers to be erected by the Olympic Power Company of Port Angeles, has awarded the contract for construction to the Vulcan Iron Works, Seattle. The towers will be of steel construction and will be as follows: Two 160 ft. in height and two 260 ft.

To provide for accommodation necessary by increase of staff, R. B. Elder has removed his quarters from the ground floor of the Rialto Building, San Francisco, to Rooms 503, 505, 509 and 511 same building, where the business of the Moloney Electric Company, of St. Louis, and The Ideal Electric and Manufacturing Company of Mansfield, Ohio, will be transacted. An interesting display of the products of these companies has been provided.

The General Electric Company has sold to the Northwestern Electric one 2000 kw. transformer, 38,000 v. / 66,000 v. Y., and 2300 v. low tension, 60 cycles, and also a switchboard. To the Crown Columbia Paper Company, Portland, Ore., three 2000 kw. transformers, rated same as above, and a switchboard. To the Standard American Dredging Company one 1000 h.p. 277 r.p.m, variable speed, continuous service, 2200 v. induction motor, with contactor control equipment for driving main suction pump on a dredge. Also, one 750 h.p. induction motor of the same type for the same service.

Among the orders secured for the Pelton Water Wheel Company by W. D. Ward, on his recent Northwestern tour, were two additional Pelton water wheels for the Britannia Mining and Smelting Company, making a total of six Pelton wheels that the above concern has installed and contracted for. The plant is located at Britannia Beach, near Vancouver, B. C. A contract was also closed with the British Columbia Sulphite Fiber Company for a Pelton water wheel to operate a paper mill on Howe Sound. Mr. Ward reports also the sale of water wheel equipment for use in the municipal electric power plant at Spillamachine, B. C.

The new Natomas Consolidated Dredge No. 8, which has just been built to replace the one that was destroyed by fire, will be the first gold dredge with a steel hull on the Pacific Coast. It is being equipped with Westinghouse electrical apparatus and will be in operation within 60 days. A novelty in the water drive of a gold dredge is a liquid rheostat. The electrodes are not lifted from the water, but a motor-driven pump rapidly raises or lowers the surface of the water in the tank of the rheostat. Owing to the loss by fire of the Hammon and the Natomas dredges, as extra precautions all of the oil switches on the new No. 8 will be enclosed in fireproof mteal compartments. The main switchboard in the pilot house will also be enclosed in a metal compartment.

MEETING NOTICES.

Engineering and Architectural Society of Portland.

The regular weekly luncheon of the Engineering aud Architectural Societies of Portland was held at the Portland Hotel, on Tuesday, October 22d. An address was given by Hon. C. W. Fulton, ex-United States Senator, on the general subject of National Politics. Mr. A. C. McMicken, vice chairman of the Portland Section of National Electric Light Association, presided.

Energy Club.

Regular meetings of the Energy Club are held in Parlor A, Palace Hotel, San Francisco, at 12:15 on Wednesdays. All interested in power and machinery are invited to attend, there being no dues. On October 15 C. R. Wallis talked on "Street Illumination." On October 23 Geo. C. Pardee, ex-Governor of California delivered a masterly address on "Conservaion" and on October 30 B. A. Etcheverry will present a paper on "The Selection and Installation of A Small Pumping Plant."

Portland Electric Lunch Club.

Post cards for the weekly luncheons at the Hazelwood are now issued under the new title of the Electric Lunch Club, in the hopes that a great many men who are now receiving notices of the luncheons, and who are not Jovians, will feel free to come to the luncheons. On October 17 the speaker was A. M. Wilson of the Galena Signal Oil Company, Franklin, Pa., who gave us a talk on lubrication. Mr. Wilson's talk was very interesting and instructive, and was on a par with the rest of the talks which we have had before the club. On October 24 another meeting will be held.

Los Angeles Section A. I. E. E.

The Los Angeles Section of the American Institute of Electrical Engineers will meet on October 29, when J. E. MacDonald, secretary of the Joint Pole Committee, will speak on the "California Law on Overhead Crossings."

Seattle Section A. I. E. E.

The October meeting of the Seattle Section of the American Institute of Electrical Engineers was held Saturday evening, October 19, in the Assembly Hall, eighth floor of the Central Building. Dr. C. E. Magnusson, who has spent the past year on special electrical engineering and investigation work at Schenectady and other parts of the East, read a paper on "A Western Engineer in the East," giving a close insight into the very recent developments and methods in Eastern practice.

The executive committee has divided the membership into groups as listed below, and each group will be assigned one meeting during the coming year and will select the subject and furnish the paper thereon:

1.—Railway: A. A. Miller, Westinghouse Electric & Manufacturing Company, chairman; G. A. Richardson, Robert Howes, D. C. Barnes, A. M. Chitty, Chas. W. Reynolds, H. T. Edgar, L. R. Coffin.

2.—Transmission, Substations and Distribution: Glen Dunbar, City Lighting Plant, chairman; C. R. Collins, G. H. Smith, M. T. Crawford, B. B. Beckett T. C. Smith, W. E. Keeney, E. R. Nigh, R. A. Hopkins, F. A. Phipps, S. C. Lindsay, R. R. Easter, G. G. Gunderson, F. McKeen, L. E. Dickenson, A. Jacobson, Chas. Terrill, A. Shipeck, C. E. O'Tyson.

3.—Power Stations—Steam and Hydraulic: J. Harisberger, Puget Sound Traction, Light & Power Company, chairman; E. G. Allen, F. R. Bates, A. R. Haynes, T. W. Northrup, E. G. Robinson, O. N. Wiswell, J. M. Kinkaid, J. T. Heffernan, P. H. Ridgway, W. J. Santmeyer, J. F. Conway, G. E. Quinan, W. C. Butler, Henry Hull.

4.—Telephone and Telegraph, including Wireless Telegraphy: L. P. Crim, Pacific Telephone & Telegraph Company, chairman: C. H. Judson, H. F. Anderson, O. D. T. Brandt, E. C. Lange, P. D Naugle, H. W. Read, F. G. Simpson, O. C. Warner, R. E. Thatcher.

5.—Electrophysics: C. E. Magnusson, University of Washington, Chairman: A. E. Scow, J. D. Ross, T. L. Proctor, W. L. Hoffman, Elmer Dover, C. W. Colby, W. K. Akers, C. G. Worthington.

6.—Electric Lighting, including Interior Construction and Illumination: E. S. Code, Westinghouse Electric & Manufacturing Company, chairman; W. T. Batchellor, G. W. Cooley, Howard Joslyn, B. W. Collins, L. Evans, W. G. McKeen, D. P. Pierce, W. D. Shaw, B. O. Stare, A. W. Woodville, A. S. Wheeler.

7.—Industrial Power: W. S. Hoskins, Hoskins Machine Works, chairman; C. M. Bliven, E. J. Barry, T. S. Clark, W. H. Harold, W. A. Danielson, W. R. Hendrey, J. H. Hodgson, J. R. King, M. C. Lord, T. E. McMullen, W. M. Price, A. E. Ransom, J. L. Wright, R. J. Andrus.

Spokane Jovians.

At the regular meeting of the Spokane Jovian League on October 8, Condon R. Bean, local representative of John R. Roebling's Sons Company, was unanimously chosen as Statesman for the ensuing year and his name sent to headquarters with the request that he be appointed. V. G. Shinkle, who has so ably served as Statesman for the past year was not a candidate for re-election. H. G. Peterson of H. W. Johns-Manville Company, gave a splendid illustrated address on "Asbestos and Its Manufacture." A. L. Wright gave an address on "Electric Block Signal System," and after the luncheon the entire body took a trip as guests of The Washington Water Power Company on their interurban line and saw the actual workings of the block signal system, same being explanied and demonstrated by R. A. Willson, general superintendent of railway of The Washington Water Power Company.

CHICAGO TO MILWAUKEE ON A SINGLE CHARGE.

It is sometimes stated that electric cars are only adapted for short runs, and are not practical for bad roads. Although electrics are most frequently used for city and suburban services, yet the run recently made by a Borland-Grannis electric from Chicago to Milwaukee on a single charge of an "Exide" Battery proves that the electric car will give long mileage and can be satisfactorily operated under adverse weather and road conditions. The Borland electric car covered the 104 miles from Chicago to Milwaukee and for 54 miles of this distance the route was over muddy country roads, and the run was made during a pouring rain. The battery equipment consisted of a standard 40 cell Type 11 MV "Hycap-Exide" Battery, manufactured by The Electric Storage Battery Company.

NEW CATALOGUES.

The Technical Book Shop, Rialto Building, San Francisco, has issued a 32-page Descriptive Catalogue of Engineering Books which they carry in local stock.

The Crocker-Wheeler Company of Ampere, N. J., is distributing Bulletin Nos. 155-156, the former dealing with induction motors and the latter with motor-generator sets.

American Ever Ready Company have recently issued two new catalogues, one dealing with Portable Lights and Tungsten Batteries, the other with Christmas Tree Outfits for Decorative Lighting.

The Benjamin Electric Manufacturing Company is distributing a new catalogue B-20, on Wireless Clusters and Lighting Specialties. The publication which contains eighty pages is attractively arranged and profusely illustrated.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

NEW ELECTRICAL WIRING ORDINANCE AT PORTLAND.

On August 5th there went into effect in Portland, Oregon, a city ordinance regulating "Inside Electrical Construction."

This ordinance was formulated by a joint committee representing all the electrical interests in Portland, Oregon. Mr. F D. Weber, electrical inspector for the Underwriters' Equitable Rating Bureau, presided over this committee as chairman.

There has been about ninty contractors who have registered with the city electrical department. The electrical inspection department is a part of the city building department and is not an independent department. Therefore, this ordinance is an amendment to the Building Code for the City of Portland.

Section 1. That Section 767 of Ordinance No. 21455 of the City of Portland, entitled, "An Ordinance regulating the construction, erection, enlargement, raising, alteration, repair and use of buildings, and to provide for protection against fire and providing a penalty for the violation of the same," approved by the Mayor, June 24, 1910, be amended to read as follows:

Registration of Electrical Firms.

Section 767. Every person, firm or corporation engaged in conducting the business of placing or installing electrical wires, appliances or apparatus, or construction in or on buildings in the City of Portland, shall appear in person or by duly authorized representative at the office of the Department of Buildings and shall there register his name and place of business in said city and make affidavit that such name and place of business as thus registered are correctly stated, and thereupon shall be entitled to a certificate of registration from said department; provided, that no such certificate shall be granted for more than the period of one year or portion thereof unexpired.

It shall be unlawful for any person, firm or corporation to engage in conducting the business of placing, or installing electrical wire, appliances, apparatus, or construction in or on buildings in the City of Portland, without first obtaining a certificate of registration from the Department of Buildings, and said certificate must be renewed as herein provided for within thirty (30) days after the first day of January of each year.

Contractor's Bond to Be Furnished by Contractors.

Section 768. Every person, firm or corporation engaged in conducting the business of placing or installing electrical wires, appliances, apparatus or construction in or on buildings in the City of Portland, before registration, shall execute a bond to the city in the sum of five hundred ($500) dollars, with good and sufficient security for the faithful compliance with the provisions of this ordinance, and said bond shall be approved by the Mayor and filed with the City Auditor.

No Electrical Work to Be Done Without Permit.

Section 769. That all companies, firms, co-partnerships, corporations or persons (except public telephone, telegraph, fire alarm and messenger call companies operating under a regular franchise granted by the City of Portland and already under bonds to the City of Portland), who desire to have electric wiring, electric fixtures, appliances or apparatus installed in or on any building (except the installation of services wires and meters by the electric light and power service companies operating under franchise, and the installations in their power houses and sub-stations), shall procure a permit from the Department of Buildings. The term "electric wiring" herein used is intended to mean the installation of electric wire, fixtures, appliances or translation devices, or the addition to any wire, fixture, appliances or translation devices to be used in or on any building for the purpose of transmitting or translating electrical current for electric light, heat or power, lighting fixtures or installing electrical apparatus or translating devices of any nature, kind or description.

The Chief Inspector of Electricity, may, at any time, grant a permit for a temporary installation for a stipulated time, such times not to exceed thirty (30) days.

Fees for Permit.

Section 770. In order to procure a permit for the installation of electrical wiring the said companies, firms, copartnerships, corporations or individuals shall, before having any electrical work commenced or any addition made to old wiring, make written application to the Department of Buildings, and shall pay the city treasurer, as a fee, the amount as required by the following schedule:

For electric light installation, for each outlet of 250 watts or less, where current is issued or controlled, 5 cents.

Outlets in excess of 250 watts shall be considered as one outlet for each 200 watts or fraction thereof, said outlet issues or controls.

For Power Installation.

For each unit, 25 cents, and an additional charge of ten (10) cents for each kilowatt or horsepower capacity or fraction thereof; horsepower being applied to motor installation and kilowatt to generator installations.

For installation, alteration or extension of new or old fixtures, same charge to be made per receptacle on fixtures as specified in the above schedule applying to outlets, except that when cord drops are hung in connection with exposed wiring of not more than three (3) drops, one permit may be issued for both outlets and cord drops without extra charge for said drops. The word "fixtures" as used above shall be construed to mean any receptacle for the reception of any electrical device. The term "cord drops" shall be construed to mean cord drops and sockets, or socket and receptacle alone. This does not apply to flush receptacles.

In estimating the cost of the permit, the same shall be taken to the nearest fifty (50) cents, and the minimum fee shall be fifty (50) cents.

Signs.

For each electric sign a rate of one ($1.00) dollar will be charged when the total number of lamps used does not exceed forty (40), and one ($1.00) dollar per hundred or part thereof in excess of forty (40) sockets.

Fees for Temporary Installation.

Inspection for temporary installation for show windows, exhibitions, conventions and the like shall be charged for at the rate of one ($1.00) dollar for the first forty (40) sockets, and fifty (50) cents per hundred thereafter in excess to forty (40) sockets.

For inspection of electrical apparatus for which no fee is herein prescribed a fee may be charged of not exceeding seventy-five (75) cents per hour for the time actually consumed by each inspector in making the inspection.

[To be continued.]

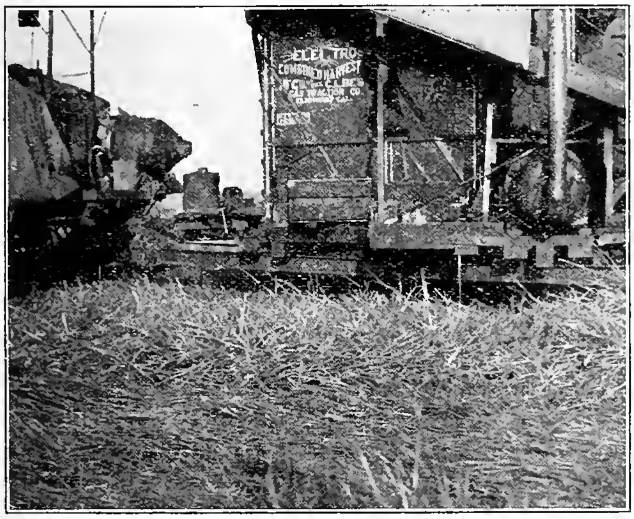
CONTRACTORS' NOTES.

The electrical construction work on the new Wigwam Theater, at Twenty-second and Mission streets, San Francisco, has been awarded to the Central Electric Company at $3500. Charles T. Phillips is the electrical engineer for the theater company.

INDUSTRIAL

AN ELECTRIC HARVESTER.

Harvesting of grain in California and farming practice in general has always differed somewhat from methods followed in the East. In the Eastern States, where summer showers are frequent, and even in some portions of California, it has been done by reapers or binders, which would allow the grain to cure while lying on the field for several days. In California the farmer has always allowed the wheat to become dead ripe and then cut it with a header. From the header it was formerly stacked or put direct through the thresher on the field. The next step was a traveling thresher, the whole outfit being propelled by horses and called a harvester. Latterly the horses have been replaced by the traction engine. The old-time method was therefore either binding the grain and putting it in shocks or else heading and stacking, or heading and threshing. Any one of these three methods requires for each threshing machine thirty or forty head of horses and nearly as many men, and the cost per acre for any of these methods is approximately $3.50,

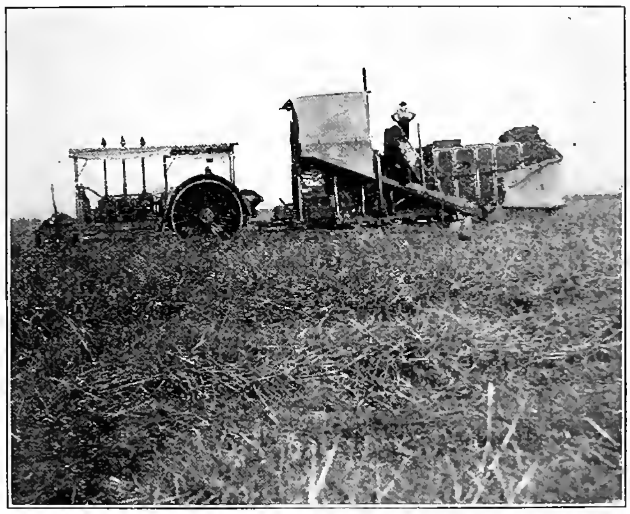


Generator Mounted on Tractor and Motor on Thresher.

C. L. Best Traction Company have developed an electric harvester which they state will cut the grain, thresh, reclean and put it in the sack ready for market at a cost of 80 cents per acre. The equipment comprises a six-cylinder gas traction engine which has mounted upon the rear of it a 20 kw. direct-current General Electric generator built specially for the work with a view of being enclosed like a street-car motor, as it must operate in dirty places much as a street-car motor has to do. This generator runs at 1200 r.p.m., 250 volt, and is shown in illustration mounted on the traction engine which is trailing the thresher. This picture also shows the motor mounted on the thresher having a pipe to deliver circulating air to the motor. This pipe is led above the machine in order to get clean air, the lower levels of air being too dirty for this purpose. It has a shaft extended forward and is driven by an endless belt from the flywheel of the gas engine. Upon this belt there is a spring-tightener that keeps it at an even tension.

Hitched to the tractor is a "C. L. B." combined harvester, which is a threshing machine on wheels with a header hinged to it and a recleaner built within the machine. This machine cuts, threshes and recleans the grain in one operation. The average amount of work one of these machines will do is approximately 2200 bushels per day of ten hours. The entire mechanism of this combined harvester, including the threshing cylinder, the various parts of the separating machinery, the header, the cutting mechanism, the conveying machinery, from header to recleaner, is run by a 25 h.p. motor, direct-coupled to the threshing cylinder, which in turn drives the belt and the machinery. The motor is the same general type as the generator, being enclosed, and is rated at 25 h.p., 950 r.p.m. The accompanying illustration shows the straw distributed in windrows over the field. This is an advantage over the old system that left the straw in stacks where it could not be plowed in or conveniently disposed of.

The advantage of the electric drive is a lessening of weight in the outfit. The old method of driving the threshing apparatus was through traction which was inefficient and expensive to produce. With the electric drive the power is transmitted from the main engine, or what we might call a portable central station, to the threshing machine by means of a cable. The motive power for operating the thresher is condensed in as little weight and as little space as possible.



Tractor and Combined Harvester in Field.

This same traction engine in the fall and spring can be used for plowing, harrowing, drilling or discing any kind of land for about half what it can be done with horses, and where feed is high and scarce, much less than half.

The gas traction engine is 80 h.p. and six cylinder, has three speeds forward and reverse, all steel geared, spring mounted. The harvester has a 38 in. cylinder, 54 in. separator, 25 ft. to 35 ft. cut, 48 in. draper, 54 in. cleaner. It requires an engineer for the traction engine, a separator man for the harvester, header runner to adjust the header to various heights of the grain, and four sack sewers (two tenders and two sewers).

The Wall Street Journal of October 9, 1912, states that the Western Electric Company seems determined to make a record in the continuity and regularity of its monthly increase. July was 3 per cent ahead of the preceding July, August was the same percentage ahead of the same month in the preceding year and September now reports an increase of 4 per cent over September of 1911. The nine months so far reported show a gain of 3 per cent over the same period a year previous, so that it now appears that the company will run close to the early estimate of a gross business for 1912 of about $67,000,000.

NEWS NOTES

ILLUMINATION.

NEW WESTMINSTER, B. C.—The city council is seeking a site for a municipal gas plant for which $225,000 was voted last June.

IDAHO FALLS, IDAHO.—This place will vote November 19 on the question of issuing $35,000 in bonds for completing the hydroelectric plant.

WENATCHEE, WASH.—This place will soon vote on the question of issuing bonds in the sum of $6000 for cluster lights; $5000 for automobile fire apparatus and $4500 for installing a fire alarm system.

MORTON, WASH.—The Morton Electric Light Company, a subsidiary of the Metcalf Shingle Company, has petitioned the county commissioners of Lewis county for a franchise to furnish light and power to this place.

SHELTON, WASH.—Wickstrum & Company, engineers, Epler building, Seattle, have plans completed and are asking for figures to convert the plant of the Shelton Electric Company, Shelton, Wash., from coal to crude oil. The new equipment needed includes oil burners and pumps, a 500 barrel storage tank and 600 feet of 4-inch wooden pipe.

SANTA ANA, CAL.—Suit to enjoin the city of Newport Beach from selling bonds in the sum of $25,000 recently voted for a municipal lighting plant, has been filed in the superior court by C. H. L. Ghriest. The complaint asks the court to declare the bonds invalid and to make an order restraining the municipal government from issuing the securities.

GLENDALE, CAL.—The railroad commission has granted an order permitting the Pacific Light & Power Company to purchase the distributing system of the Glendale Light & Power Company for $5200. The Glendale Light & Power Company has been serving the city of Tropico. The Pacific Company made an offer, provided permission was given it to purchase the system of the Glendale Company of Tropico to reduce the rate on electric energy from 15c to 8c per kw. and to reduce the minimum charge from $1.50 to $1 per month. The company also offered to make all service connections free of charge, although the Glendale company has heretofore charged 20c for each connection. Provision is made in the order for the possible purchase by the city of Tropico of this plant.

STOCKTON, CAL.—The Oro Electric Corporation is soliciting contracts for domestic lighting at a graduated rate starting at 6½c per kw.-hr., preparatory to applying to the railroad commission for permission to compete in that municipality with the Western States Gas & Electric Company, which is now supplying that service for 7c per kw-hr. When the Oro Company makes its application the commission will institute at once an investigation of the reasonableness of the lower rate, to discover whether it is being offered merely so that the company may secure permission to enter the territory, or whether it will really result in a fair return on the property investment. The Oro corporation has given notice that the rate will stand, and will be defended as sufficient to bring in a proper return.

TRANSMISSION.

NYASSA, ORE.—R. W. Purdam of Nampa and associates, have recently surveyed the E. P. Bonnell power site and reservoir above Horseshoe Bend in Idaho. The object of the reservoir, aside from the establishment of a power plant, is to furnish water for an irrigation project near here comprising 30,000 acres of land.

FRESNO, CAL.—The San Joaquin Light & Power Company has entered into an agreement to erect a power line from Chowchilla, on the Southern Pacific, to the center of the tract which has been placed on the market for settlement by the United States Farm Land Company. There will be 108,000 acres in the sub-division, and the power line, which will be about ten miles in length, will furnish the motive power for pumping purposes.

REDDING, CAL.—Seven thousand pounds of machinery have been shipped from here by teams to the Mt. Shasta Power Company in the Big Bend of Pit River. The machinery comprises a portable power plant, including an air compressor that will furnish air for operating drills. The company is working a small force of men at each end of its proposed seven-mile tunnel. The Mt. Shasta will eventually develop 200,000 h.p. of electrical energy.

SAN FRANCISCO, CAL.—A four-year contract providing for the sale of power has been secured by the Northern California Power Company with the Oro Electric Corporation. Under the terms of the contract the Oro corporation is to take what power it needs to fill its requirements up to a maximum of 3000 kw. The power will come out of the Northern California's large surplus supply and will be transferred over high tension wires meeting below Hamilton.

DOWNIEVILLE, CAL.—The Marysville & Nevada Power Company, promoted by James O'Brien of Marysville, is advertising for bids for running a tunnel to divert the waters of the river at Goodyear Bar for the purpose of generating electricity. The water is to be taken through a point and dropped to the power house. A dam will be built next year to raise the water to the level of the tunnel. Jason M. Meen and John E. Ebert, both of Marysville, are associated with O'Brien in the enterprise, as is also James K. O'Brien.

BOISE, IDAHO.—The Great Shoshone & Twin Falls Power Company which recently was merged with the Idaho Consolidated Power Company and has plants at American Falls, Shoshone Falls and Salmon River, Idaho, is building a new concrete dam across the Snake River at American Falls, where a new generating station, with larger capacity, is being built. Work is being rushed on the concrete work night and day, and the plant is expected to be in operation by February 1, 1913. Power will be transmitted to Salt Lake City or Boise. Lines have already been laid to Shoshone and Mountain Home. It is reported that the Great Shoshone & Twin Falls Power Company has received an inquiry from Thos. A. Edison regarding a proposition to build a factory at Twin Falls for the manufacture of the new Edison Storage Battery.

SAN RAFAEL, CAL.—The Pacific Gas & Electric Company has recently entered into some important construction work that when completed will insure improvement of the company's electric service, not only in San Rafael but throughout the entire county of Marin. A new line has been started to run from the company's substation at Cordelia above Vallejo through San Rafael to Schuetzen Park, a distance of 34½ miles. The purpose of this is to supply the main feeder and insure permanent and uninterrupted service to the consumers of electricity for all purposes. Plans and estimates have been approved and the work is actually started. The new line is to be of the most modern equipment and will be a steel tower line throughout. It will take about 200 of these towers to support the wires that will carry the current. The towers will be 78 ft. in height, but besides this there will be needed a considerable number of higher ones ranging between 175 and 200 ft. in height for the purpose of crossing the various creeks and sloughs that lie between Cordelia and San Rafael. The contract has been let to the Duncanson-Harrelson Company of San Francisco.

PORTLAND, ORE.—The State Supreme Court of Washington has affirmed the right of the Northwestern Electric Company to condemn a power site at Lyle, Wash. The power, land and water rights originally were owned by Ham, Yearsley & Ryrie and George S. Canfield of Spokane. Messrs. Yearsley and Canfield succeeded to the interest when the firm was dissolved. The power properties were sold to the Northwestern Electric Company, a Washington and California corporation, the local men retaining the land and water rights. The right of the company to condemn land in Lyle townsite was at this juncture attacked by C. D. Keasey, and after the case was decided against Keasey in the Superior Court it was carried to the Supreme Court. According to Mr. Canfield, the electric company, which has been doing work in a small way, will at once proceed to develop 10,000 horsepower from their Klickitat River power plant. A total of 25,000 horsepower is available. This will be combined with power from a plant on the White Salmon River and taken to the City of Portland, where it will be used for light and power in competition with the present Portland Railway, Light & Power Company.

TRANSPORTATION.

EUGENE, ORE.—The advent of the Oregon Electric Railroad, connecting Portland with Eugene, was joyously celebrated on October 15.

LOS ANGELES, CAL.—Stockholders of the San Antonio & Rio Grande Valley Interurban Railway Company have authorized an issuance of bonds to amount of $10,000,000, proceeds of the issue to be used in the construction of about 250 miles of aditional road.

STOCKTON, CAL.—The railroad commission has amended its previous order granting to the Stockton Terminal & Eastern Railway company the right to issue bonds to the amount of $65,000. Under the original order this company was given the right merely to sell these bonds. The company desired to place the bonds as collateral for loans, and, in fact, had placed a portion of such bonds as collateral, thus unintentionally violating the original order. The amended order was made so that the company might issue these bonds as collateral and also validate the bonds which were already issued as collateral.

RICHMOND, CAL.—The Southern Pacific Company has completed all negotiations for the extension of its transbay electric service from Alameda and Berkeley to Richmond via the town of Albany, and all that now stands between the conclusion of these negotiations and the beginning of construction work is the approval of the State Railroad Commission. This was the information obtained by the commission Monday at a hearing of the railroad's application to purchase the Nichol street railway franchise in Richmond revealed that H. C. Cutting, who also enjoys a Richmond franchise, was acting as an agent of the Southern Pacific when he acquired it. Cutting's franchise provides for the right to construct a line that will extend from the termination of Nichol's franchise to the Richmond boundary line and from the boundary to Albany.

SACRAMENTO, CAL.—The State Railroad Commission has conducted a hearing into the application of Northern Electric Company for the issuance of $8,500,000 in bonds, the proceeds of which it is proposed to utilize for the taking over of the Vallejo & Northern Railroad and the completion of the extension from Vallejo to Sacramento. In response to a question asking the present value of the Northern Electric, one of the officials declared it was in the neighborhood of $7,500,000 in June of this year, but is now $10,000,000. The Commission endeavored to ascertain the reason for the increase in value, but the answer was amended so as to make the estimated valuation of the road between $8,000,000 and $10,000,000. Schindler revealed that it is proposed to use $6,500,000 of the proposed bond proceeds for construction work in extending the Vallejo & Northern to Sacramento. One point brought out was that with the new bond issue granted, the new road might be bonded for more than its worth, but the railroad's attorney explained that it was proposed to keep a fund of $1,000,000 on hand at all times to guarantee interest debt. If the application is granted the bonds will be issued in franc and pound sterling denominations, as the company has secured foreign capital for its work.

TELEPHONE AND TELEGRAPH.

RIALTO, CAL.—Bids will be received up to December 3 for a franchise to transmit electricity for telephone and telegraph purposes along public thoroughfares of this city.

VACAVILLE, CAL.—The petition of H. G. Brown and others asking for permission to erect and maintain a telephone line along certain public roads from Dixon to Maine Prairie has been granted.

MODESTO, CAL.—The petition of the Evans Telephone Company for permission to place and maintain poles and wires over and along the highways in the vicinity of Patterson, has been granted.

PORTLAND, ORE.—The Portland Young Men's Christian Association has completed the installation of one of the most modern wireless telegraphy plants in the west, and is going to form a club for the study and discussion of wireless.

LOS ANGELES, CAL.—The final decree in favor of the city of Pomona in the suit of the Sunset Telephone & Telegraph Company against the municipality has been signed by Federal Judge Wellborn. The suit decided in favor of the city of Pomona several months ago involved the right of a municipality to regulate corporations operating within its confines. Judge Wellborn heard the case originally. He favored the city of Pomona. The Sunset company carried the matter to the U. S. Circuit Court of Appeals, where Judge Wellborn was reversed. The city of Pomona then carried the litigation still higher and the U. S. Supreme Court in a decision rendered last April affirmed Judge Wellborn's ruling. The suit was of interest to all municipalities, and during its trial the court was packed with attorneys interested in the legal questions involved. The Sunset company was operating in Pomona without a franchise, and upon its refusal to secure such a license the city superintendent of streets was ordered by the councilmen to cut down the poles of the company. This action was stopped five days later by injunction proceedings. The case then tried out in the courts. Judge Wellborn received the mandate of the higher court to issue the final decree and allow the appellant costs of $826.92.

SAN FRANCISCO, CAL.—Arguments on the demurrer of the Pacific Telephone & Telegraph Company to the city's action for the dissolution of its consolidation with the Home Telephone Company, were heard before Judge John F. Ellison of Tehama County in extra sessions No. 1, of the superior court. Thomas E. Haven, on behalf of the city, argued at great length in an attempt to establish the doctrine that the franchise and the physical property of the Home concern were a single and inseparable legal entity, which could not at this time be separated. Calling attention to another provision of the Home company's franchise, Haven declared that the attempted merger between the two concerns was an attempted evasion of the city's right to collect 2 per cent of the Home company's net receipts. Attorney Thomas replied on behalf of the Pacific company. He could see no legal obstacle in the way of the sale of the Home's physical assets. What he thought would be legally impossible would be the separation of the company's tangible property from the use of that property. The Anglo-California Bank, trustee for the bondholders of the Home company, was represented by counsel. The case was submitted, with 30 days within which to file briefs and authorities.

ALPHABETICAL INDEX TO ADVERTISERS

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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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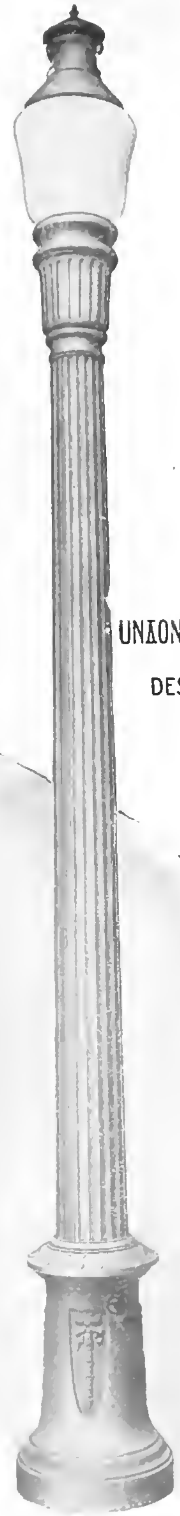
Where to Buy It in the West, Pages 9, 10. Alphabetical Index to Advertisers, Page 8.

REMEMBER

UNION LAMP STANDARDS



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POWER AND GAS
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VOLUME XXIX | SAN FRANCISCO, NOVEMBER 2, 1912 | NUMBER 18

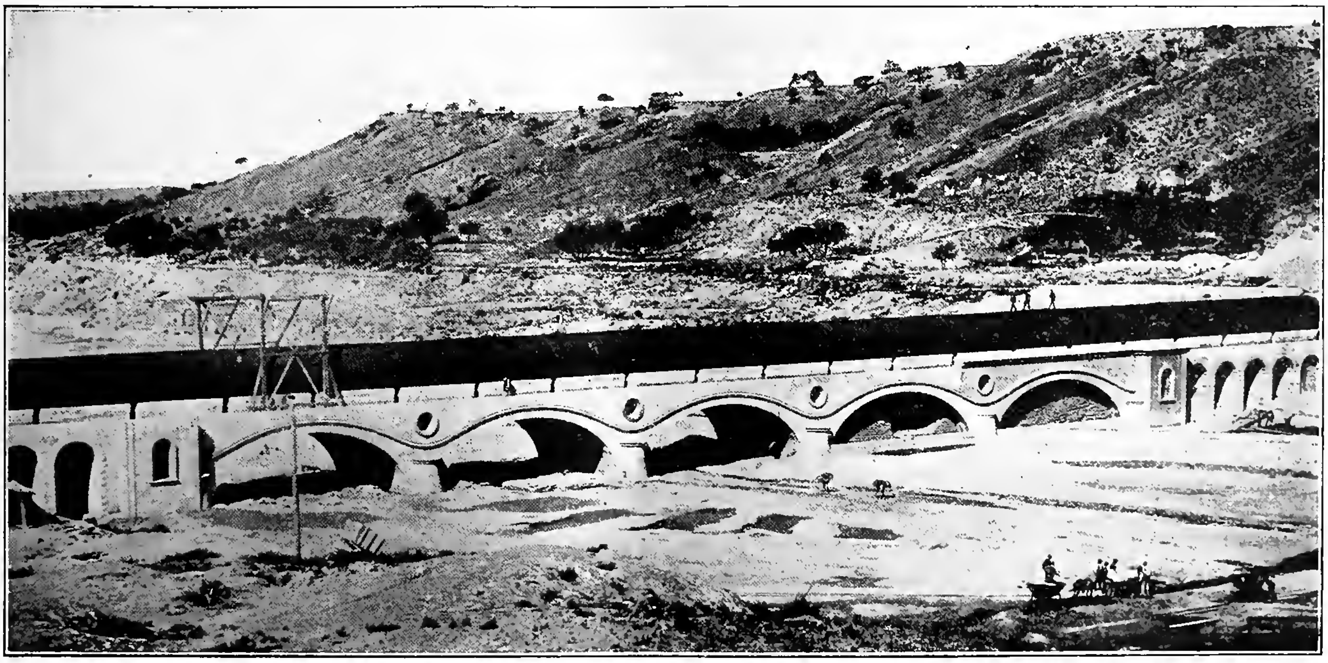
ELECTRIC PUMPING AND IRRIGATION

BY B. A. ETCHEVERRY.[1]

General Character and Parts of a Gravity Irrigation System.

Water for a gravity irrigation system is ordinarily obtained by building a dam or diversion weir across a stream, thus checking the water and forcing it to flow into the head of a canal. By making the grade of the canal less than that of the stream sufficient elevation is gained to reach the higher points of the land to be irrigated some distance from the stream. This portion of the canal is called the diversion line.

The character and the cost of the diversion line construction is determined by the topography. If the diversion site is high up on the river where it runs through rough hills or deep canyons the construction will be correspondingly difficult and expensive. Where a hillside is too steep for open canal excavation, a flume must either be supported on a bench cut in the hillside or a concrete rectangular section must be made with a retaining wall on the down-hill side. Where depressions must be crossed with flumes or siphons or where ridges are tunnelled, especially with a long diversion line, the cost is considerable. Where the diversion dam can be constructed lower down the stream where it emerges into the valley the installation is simpler and the diversion line shorter, thus materially reducing the cost.



Sosa Bridge, Spain.
(This is a three-hundred thousand dollar siphon structure completed abroad in 1905 and illustrates obstacles to be overcome in crossing dry washes.)

From the highest point of the area to be served the main canal is continued so as to skirt the land. The main branches or laterals head at the main canal, and, when possible, run down the ridges that separate the smaller valleys constituting the system. These laterals either supply the farms directly or feed sublaterals.

Drainage channels are provided to receive all excess or waste water from the main canal and laterals

[1]Head of Irrigation Department, University of California, and Irrigation Expert U. S. Department of Agriculture.

so as to prevent the land from being waterlogged or to avoid the accumulation of alkali. These drains may be either natural, occupying the previous drainage lines of the sub-basins and deepened or straightened where necessary, or artificial.

It is thus seen that the parts of an irrigation system may be classified into five main groups with their corresponding subdivisions as follows:

The land and crops.

The source of water supply.

The diversion canal and appurtenances.

- Diversion weir with scouring sluices, fish-ladder, log-way.
- Canal headworks, with regulator and spillway.
- Waterways or escapes to control excess flow in the canal.
- Sand gates or boxes to remove sand or silt.
- Falls and chutes to regulate canal grades and velocities.
- Flumes, inverted siphons and culverts to cross depressions or drainage channels.
- Bridges and culverts to cross roadways.

The distribution system and pertaining structures.

- Check gates in the main canal to control or raise the water and force it into one or more branches or through an escape.
- Headgates or turnout gates at the head of laterals to control the flow into them.
- Division boxes at the head or junction of small laterals or farm ditches.
- Wasteways, escapes or spillways located at drainage channels.
- Drops or rapids.
- Drainage crossings: flumes, siphons, culverts, level crossings.
- Road crossings, culverts, bridges.
- Measuring boxes or devices at point of delivery to private ditches.

The drainage system.

The character of irrigation systems vary greatly with the topography and water supply of the country. Where the irrigable area is a large body of land in a broad flat valley, and the water supply is plentiful, the system will consist of earth canals on a flat grade with few interesting structures. These will consist largely of checkgates, headgates and division boxes to control the flow into the different branches and of bridges or culverts at the roadway crossings.

Where the area is rough and steep, many difficulties are encountered on the diversion line requiring practically all the types of structures enumerated above and the planning of the distributing system requires careful consideration.

Where water is valuable and the topography rough, concrete lined canals and pipe distribution systems have many advantages and while this form of construction was until recently limited to southern California, there have been during the past few years some interesting systems of this type constructed in Oregon, Washington, Idaho and British Columbia.

The cost of construction also varies greatly with the topography and type of construction. Where the diversion line is short and where the area to be irrigated is large and the surface smooth and fairly level, but with sufficient grade to give suitable velocities in the canals, it will range between $15 and $25 an acre. Where the area to be irrigated is more or less rolling and the diversion line fairly long, $25 to $40 an acre should cover the cost of construction. Where the diversion line is long and along rough and rocky hillsides and the area to be irrigated steep and rolling, requiring considerable fluming or pipes, the cost of construction will range from about $40 per acre to $60 or even $80 per acre. The lower price in each case is for favorable conditions and less permanent construction.

Before undertaking an irrigation project, the promoters must know its general feasibility, as determined by preliminary investigations. The cost of these investigations must usually be kept down to a minimum and this often precludes the making of a detailed examination and surveys. The engineer can frequently obtain the necessary information by consulting the reports, bulletins, and maps of the different bureaus of the U. S. Department of Agriculture, Department of the Interior, or any other information compiled by the state or private sources.

A general field examination of the project is often warranted and in some cases the importance of the project and the lack of available information may justify extensive hydrographic and topographic surveys. Usually the investigations will cover the land, the crops which may be raised, the water supply, the ownership of the land, and the cost per acre of construction of the system. These factors are related and must be considered together.

The Land and Crops.

The determination of extent of irrigable area includes an estimate of the land area to be covered by the system and of the proportion of the land to be actually irrigated to the total area under the system. For this work the engineer may in some cases be assisted by the topographic maps of the U. S. Geological Survey, or by state, county and private maps.

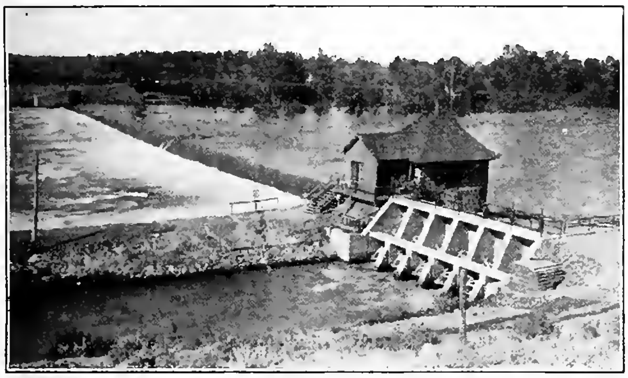
The configuration of the country will affect not only the cost of construction of the canals but the preparation of the land for irrigation. Rough land makes the cost of construction of the canals and the preparation of the land high. A flat slope may limit the velocities in the canal, making large canals necessary; it also makes it difficult to install measuring devices and to deliver water to the farms at sufficient elevation. The best land is that which is smooth and has a fairly good slope.

The character of soil and vegetation is determined by borings with a soil auger, by means of which soil samples are taken for analysis and the depth and physical condition of the soil observed. The presence of hardpan close to the surface is a serious detriment. Where soil surveys have been made by the U. S. Bureau of Soils, the borings may not be necessary. The character of the vegetation is an indication of the character of the soil; sagebrush, cactus and buffalo grass grow on good deep soils; salt grass and other alkali weeds grow on land which may contain considerable alkali.

An impervious clay soil or a tight silt soil through which the water will percolate slowly, or a soil which will puddle, bake or crack after irrigation, is hard to irrigate and cultivate. A soil which is too porous will make it difficult to irrigate without loss due to deep percolation.

The presence of alkali in the soil and the lack of natural drainage must be carefully looked into. The practice of irrigation will usually aggravate the alkali conditions, especially at the depressions where seepage water from irrigation canals or from wasteful irrigation on higher lands leaches out the salts from the higher lands, water-logging the land and concentrating the salts at these depressions. While the natural sur-

face drainage may seem adequate, the surface soil may be underlaid with hardpan or impermeable strata or dikes which interrupt the subflow and not only interfere with drainage along the natural drainage lines but also produce water-logging and rise of alkali at the foothills, although the open texture of the soil may seem favorable to good natural drainage. Borings or test pits are necessary to determine the character of the subsoil. There are few irrigation systems where drainage is not necessary and the construction of an irrigation system generally includes a drainage system.



Headworks of Yakima Sunnyside Project, Washington.

The character of crops depends on the soil, elevation and all climatic conditions. Valuable information may sometimes be obtained from observations of crops grown in surrounding regions under similar conditions.

The demand may be local, but usually for an extensive area there must be a general demand. The possibilities for development of various industries such as creameries, sugar factories, mills, fruit packing houses, canneries, must be investigated.

The cost of producing comprises: (1) interest chargeable to the cost of the land including the cost of irrigation works, preparation of land and all improvements, (2) cost of maintenance and operation for irrigation water delivered, and (3) labor cost of applying water and cultivation, harvesting, etc.

Concrete Retaining Wall on Modesto and Turlock Canals.

The cost of marketing will depend on the distance from market; on the means of communication, either railroad or navigation; and on the character of product to be marketed. For instance alfalfa may be used for dairy purposes; sugar beets may be marketed in their natural state or manufactured into sugar prior to marketing.

On the value of crop will depend largely the feasibility of the project. A project which might be prohibitive in cost for raising grain or alfalfa may be quite feasible for orchards.

The ownership of the land is either public, or private, belonging either to the canal builders or private owners. In the case of public lands, unless the lands and system be developed under the Carey Act, the result is usually disastrous to irrigation companies. The land is largely taken up by speculators who hold down their claim without using the water or purchasing a water right, waiting until they can dispose of their holdings to a real settler at a high profit, thus deriving all the benefits of the system. This results in slow development, the company receiving little revenue, while the interest on their capital and the depreciation of the system means ruin to the investors. The same conditions, but a less extent, are liable to prevail where the lands belong to private individuals unless they will sign contracts for the purchase of water rights and agree to pay the annual charge of operation. In this connection it is well to investigate the present character of the use of these lands and whether irrigation is necessary or simply desirable. The possibility of changing to a system of agriculture requiring water must be looked into and whether this can best be done by converting those already on the land or by immigration colonies. Generally an irrigation company can not be financially successful unless the land and the irrigation system are under the same control, for the profits come from the increased value of the land and not from the annual sale of water.

Concrete Lined Tunnel, Truckee-Carson Project.

The cost of the system cannot be closely estimated without the surveys, examination of the ground and design of the structures, but an approximate estimate can be made by a general examination of the character of the land to be irrigated and of the general topography along the probable location of the diversion line, assisted in some cases by preliminary survey lines or hasty reconnaissance survey. As a rule the estimates of cost are too low. The actual cost of construction is only one item of cost. The other items, for which due allowance is not always made, are:

1st. Preliminary surveys, designs and estimates which may be estimated at 5 per cent of construction cost.

2d. The expense of organization and promotion with the reimbursement of original promoters, estimated at 10 per cent of construction cost.

3d. General adminstrative expense during construction period, estimated at 10 per cent of construction cost.

4th. Interest charges on bonds during the construction period (2 to 5 years) and the settlement period (2 years) will amount to 20 to 30 per cent of construction cost.

The total of these items shows that the bond issue must exceed the actual engineering cost of construction by at least from 45 to 55 per cent, depending on the period of construction and settlement.

The sale price of the land should include the total cost of construction and development, the purchase price of the land, the commission for the sale of lands which may amount to 10 or 20 per cent of the sale price of the land if disposed of in small tracts and the profit which should be commensurate with the risk involved.

Miscellaneous Considerations include rural advantages such as the existence or establishment of churches, schools, roads, etc., and the available fuel such as gas, electricity, wood, oil, coal, especially important where pumping is necessary.

Water Supply.

A study of all rainfall data, the extent of precipitation, its monthly distribution and its relation to the needs of crops is important. This information can usually be obtained from the Weather Bureau of the U. S. Department of Agriculture. A large mean annual rainfall is no indication that irrigation is not necessary or desirable. The value of irrigation in regions where the annual rainfall is large is well demonstrated by the extension of irrigation in the Rogue River Valley and the Willamette Valley of western Oregon and in parts of the Sacramento Valley where a few years ago it was thought that irrigation was not desirable. In the Willamette Valley the mean annual rainfall is about 44 inches but the rainfall during the spring months of April, May and June is about 7.05 inches and during the summer months of July, August and September only 2.81 inches. Experiments made in this valley by the U. S. Department of Agriculture show that in general the intelligent application of water to crops such as potatoes, clover, alfalfa, corn, beans, onions, etc., will easily increase yields from 75 to 150 per cent. In the Rogue River Valley the total annual rainfall is about 26.57 inches, the rainfall during the spring months is 4.22 inches and during the summer months, 1.45 inches. In this valley the orchards that are producing the heaviest and yielding the largest profits are irrigated.

Study of stream flow is best obtained from gaugings extending over a number of years, especially those including periods of drought. On some streams this work has been done by the U. S. Geological Survey and the information may be obtained in the Water Supply Papers. In some states, the state engineer has done considerable work on stream gaugings, the results of which are given in his annual reports. These are the two main sources of information. At times it is possible to obtain information from private sources. If no information is obtainable it is best to establish at once a gauging station and make observations for as long a period as is possible. If the time will not permit the gauging of the stream for any considerable period an estimate of the run off may be obtained by a study of the watershed and the precipitation on it. A study of the watershed as affecting run off will include:

Area of watershed.

Character of surface—rough or smooth, steep or level.

Bare or wooded.

Elevation of watershed. An increase in elevation increases the precipitation and will retain the snow or ice later in the year, helping to maintain the summer flow.

Character of soil and subsoil with its geological formation.

Climatic conditions: temperature, wind, etc.

Probable changes in character of supply due to settlement and use of water in upper valleys.

A study of the precipitation will include:

Distribution of precipitation.

Character and extent of precipitation—whether in the form of rain or snow and whether sudden storms or gradual falls.

The U. S. Weather Bureau is the main source of information concerning precipitation. With the precipitation and the area of the watershed, the runoff is estimated by assuming a coefficient of runoff. This estimate is necessarily rough but one may obtain a fairly close approximation by determining the coefficient of runoff from stream gaugings which it has been possible to obtain for a limited period. If stream flow data from similar adjacent watersheds may be obtained, a fairly accurate estimate of stream flow may be obtained by comparison of watersheds and precipitation.

The amount and variation of the stream flow will show the relation between maximum period of flow and maximum demand of water for irrigation. An analysis of the water, especially during low water period, is necessary if there is any doubt as to its quality.

Volumes appropriated and used, and earlier rights include the volumes recorded, appropriated, and used; the volume recorded or filed on but not used; and the riparian rights in those states which recognize them. In those states where modern water codes are operative and where riparian rights are not recognized, the methods of obtaining and defining rights are provided for; and accurate information can frequently be obtained from the state engineer. In the states which have not modern codes and where riparian rights are recognized, it is difficult and often impossible to learn with any degree of certainty the extent of prior rights. An inspection of recorded rights is of little value, for without a field examination the value of the records cannot be determined. A field survey of volumes actually used and of probable future extensions is necessary. Not only the extent of the uses must be known but also the character of the uses. There are: (1) uses which may not diminish the volume, such as power and mining in some cases; (2) the uses which diminish the volume, such as domestic and stock use and irrigation of areas having prior rights or riparian rights; (3) uses which increase the flow, such as return waters from areas irrigated above or water stored for power purposes; (4) uses which affect the quality of water, such as some forms of manufacturing and mining.

The location of proposed diversion with reference

to other uses must be considered. This includes (1) the possibility of interfering with riparian or prior rights below, or the interference by increased use by riparian rights above; (2) the necessary regulation in case of stored water and the exchange of stored water where water is stored below point of diversion. The seasons of the diversions, whether continuous or intermittent, must also be considered.

Volumes unappropriated may be obtained from the stream flow data and the rights of prior appropriators and riparian owners. A study of the relation of this to the water supply needed for the irrigation system is the next consideration.

Water supply needed for the irrigation system requires a determination of the amount needed and the season of need. When the demand is greater than the available supply during part of the irrigation season, but is less at other times, the deficiency may be supplied in three ways: (1) by storage in artificial reservoirs, which will require the examination of reservoir sites and a study of available flood flow; (2) by encouraging the growth of crops which will create a demand for irrigation water at the time when the supply is most plentiful; (3) by storing water in the soil by winter irrigation or irrigation during period of maximum flow. This requires a soil which will retain the moisture and have it available for the crops during the growing season. Orchards and deep rooted crops are best adapted to this practice. This same process may be applied to the replenishing of underground waters where pumping is extensive by spreading the flood waters over the porous fan-shaped deposits formed where the stream emerges from the hills into the valleys. In southern California this is done by spreading the flood flow by means of flood ditches placed on a flat grade across the longitudinal slope of the valley. The water supply needed will be based on the duty of water.

The gross duty of water determines the capacity of the main canal and the necessary stream flow. It represents the relation between the quantity of water entering the main canal and the total area of land irrigated. It includes, besides the quantity applied to the land, all losses and waste in conveyance. The duty of water obtained on the laterals eliminates the losses occurring between the head of the main canal and the head of the laterals, and is therefore higher than the gross duty.

The net duty represents the water delivered to the field. It must be distinguished from the correct amount of water required for maximum production for it merely represents the volume of water which is used, depending on the abundance of supply and the judgment and skill of the irrigator. The correct amount of water to use is that quantity which is necessary to produce maximum yield when all the losses by percolation, evaporation and waste which can be controlled by ordinary careful methods of irrigation and cultivation have been eliminated. The net duty of water is affected by the following factors: (1) kind of crops; (2) preparation of land, method of application of water and skill of irrigator; (3) time and frequency of cultivation; (4) number of seasons irrigation is practiced because of rise in water table; (5) climatic conditions, rainfall, temperature, humidity in the air, wind movement; (6) character of soil and subsoil; (7) value of water, method of payment for water (whether for quantity used or flat charge per acre), and judgment of irrigator. This factor of cost combined with the judgment or lack of judgment may have more effect on the duty of water than all the other factors together.

The gross duty of water will depend on the net duty and on the transportation losses. The duty is generally lower for a new system because seepage losses are greater with new canals, new lands require more water, water is more plentiful as only part of the land is irrigated, and the irrigator is less skilful. As the system becomes older less water is used and the gross duty increases. This is well shown in the following table.

Gross duty of Water Under Sunnyside Canal, Washington.

Year.	Area Irrigated (acres).	Quantity of Water per acre. (acre feet).
1898	6,883	11.4
1899	8,497	10.6
1900	10,947	10.2
1901	14,964	9.6
1902	18,870	9.1
1904	32,000	6.0
1909	47,000	4.57

This table shows that after eleven years only 2-5 as much water was used as in the first year. The relation between the net duty and gross duty is illustrated by the following examples:

State.	Canal.	Gross duty, or water diverted by canal. Acre feet per acre.	Net duty, water delivered to farms. Acre feet per acre.	Per cent.	Remarks.
California ..	Gage	2.16	1.98	92	Concrete lined canals & pipe systems.
Idaho	Ridenbaugh laterals	4.79	2.50	52	
Washington.	Sunnyside	9.60	3.96	41	For year 1901
Washington.	Sunnyside	4.57	2.79	68	For year 1909

These measurements show that for the Gage Canal system, which consists of a main canal, concrete lined with cement mortar about 1 in. thick, and pipe distributaries, 92 per cent of the water diverted reaches the land. The measurements for the Sunnyside canal show the increase in efficiency of a system as it gets older. The above results indicate that in a new system of unlined earth canals, the water delivered to the farms is probably not more than 40 per cent of that diverted. For old canals in good condition the efficiency will be increased to 65 or 70 per cent.

Water supply from underground sources must be investigated where surface water is deficient or absent. The forms of occurence are usually (1) in the surface zone above the first impervious stream; (2) between two impervious strata in which case it may be under pressure and in some cases artesian; (3) below the bed of streams or natural drainage lines as an underflow. The means of development are (1) wells, either deep or shallow with pumping plants; (2) artesian wells; (3) underground collecting galleries or submerged dams to divert the underflow. The geological conditions favoring the occurrence of underground waters must be investigated. The underflow of streams can be estimated fairly closely by measurement of the cross section of the underflow channel and the velocity of flow. Where existing wells are found in the vicinity they will be helpful indicators of what may be expected.

RATE FIXING AND APPRAISAL

REASONABLE GAS RATES AND THEIR DETERMINATION.[1]

BY C. L. CORY

There is no more fundamental proposition than that the rates charged by a public utility company must not be greater than the service is worth to the customer, and must not be less than sufficient to yield a fair or reasonable return to such public utility company.

It is evident that any standard based on what a service is worth to a customer is in most cases vague and indefinite. The rates paid for the same commodity in other communities is often used, many times to the exclusion of all other factors, as a dependable and equitable guide to be followed in any given case.

Again it is often maintained that in every instance such rates must depend primarily upon the cost to the public utility company of supplying the commodity to every customer desiring such service.

Neither of these two principles can be said to be always applicable or infallible.

Thus it is that many factors are involved in the determination of the proper rates for gas service. Viewed both from the standpoint of the consumers and the companies manufacturing and supplying gas, the careful consideration of many complex, and in some cases, conflicting elements is absolutely essential for real ultimate economy and mutual advantage to both sides.

It is the object of this paper to briefly and, in a general way, discuss some of the more important details involved. to the end primarily that the discussion may indicate the way toward the adoption of, and possibly definitely establish, some principles of ultimate value to the gas industry.

Quality of Service.

While the rates to be charged consumers are of the greatest importance, the quality of the service is of more vital consequence. The supplying of gas in an urban community is more easily accomplished in some respects than the furnishing of electrical energy for light and power. Although the use of gas, like electricity, is confined largely to certain periods of the day, resulting in what are known as peak loads, and also hours of practically no consumption whatever, yet the successful storage of gas in large holders, to be drawn upon as required, eliminates, to a considerable extent, the necessity of providing a manufacturing plant proportional to the magnitude of the maximum demand, as must be done in most electrical generating stations.

As a result of the adoption of convenient and economical methods of storing gas, the manufacturing plant need be no larger than the average use throughout a twenty-four-hour day which is a manifest advantage. On the contrary, however, the distributing systems, from the gas holders to the many consumers' meters, including the trunk mains, secondary mains, laterals, and services, must be installed of such size as to provide an adequate pressure and quantity of gas to the most remote consumers, especially during the hours of maximum demand. There is a direct similarity then in this regard in the distribution systems for both gas and electric service.

Gas distribution systems in general, however, cost more per consumer, or perhaps, to put it in a better way, more per dollar per month paid by consumers, than electrical distribution systems, especially in comparison with overhead pole line construction in electrical distribution. The gas distribution systems are of a more permanent character, and should be less often changed or enlarged. The ultimate result is usually then that investments are made in gas distribution systems in advance or ahead of the immediate probable use of such systems, so that the reconstruction, enlargement and reinforcing of mains, necessitating the tearing up of pavements and continual excavation of streets, are the less often required.

But no matter how old or limited in capacity a gas distribution system may be, it is of vital importance that all customers may be adequately served with gas at the proper pressure when the demand is greatest and to meet this requirement, it in some cases may be desirable to install an automatic pressure regulator for each individual customer. While the cost of such regulators is considerable, approximately four or five dollars each, installed, the improvement in the service is very marked and inevitably results in a material reduction in expenditures for trouble men as well as other costs of correcting the troubles of customers caused by a considerable variation of pressure at the gas consuming devices.

Uniform chemical composition and thermal value in the gas supplied are also essentials of good service. Impurities, especially sulphur, are very disadvantageous to customers and often result in the very rapid deterioration and expensive replacement of gas consuming devices and auxiliaries.

Further consideration of what is proper service will not be attempted, except to emphasize most forcibly that good service is absolutely necessary. Anything less than the best reasonable service is a most serious matter to be corrected by the co-operation of the rate regulating body if any, the consumers, and the gas company at the earliest possible moment. Continued poor, inadequate, or unsatisfactory service to even a relatively small number of customers is intolerable and cannot but ultimately result disastrously to the company as well as its customers.

Almost any user of gas can probably under the pressure of threats to cut off the gas (and no possible chance to get the desired service from another company), will pay even exorbitantly large or unreasonable gas bills, but even with a flat rate of a few cents per month, poor service with impure gas of insufficient pressure when most needed, probably for cooking breakfast or dinner, and no possible relief from

[1]Paper read before the Pacific Coast Gas Association, September 18, 1912, San Diego, Cal.

a competing company, is an abomination, and is not only wrong in principle, but is directly contrary to true constructure ideals, is in direct violation of the eleventh commandment of Holy Writ and may be urged in the future life of the unhappy and tormented spirit of the abused gas user as a reason for his or her condemnation to eternal punishment; and I leave to your imagination the excuses that the responsible officials and owners of gas companies will, with parched throats and pleading and halting voices, utter while they too are struggling vainly to escape from the bottomless pit of Hades, there to be tortured for all future time with the most unheard of, preposterous and unjust complaints of payless customers, constantly reduced rates, and increasing deficits, while submerged to their necks in sticky lampblack and in a sulphurous atmosphere of a temperature and humidity, such that the heat of the fire-brick checker work in the interior of an oil gas generator when operating at full capacity would seem to be the absolute zero, minus 473° C., when compared therewith.

Mutual Responsibility of Gas Manufacturer and User.

The obligation of the gas company, then, to give good, adequate and proper service is established, providing, however, that this obligation is in reality of a mutual character, in which those controlling the rates and service, as well as the customers, accept, and continue, without repeated lapses into political intrigue, to do their honest share in the carrying out of what is, after all, a mutual contract.

In my paper last year reference was made to this important phase of the situation, but it may be well to here briefly mention some other considerations most directly relating to the determination of gas rates.

How can a company, individual, or any kind of an organization, properly and satisfactorily furnish any kind of public utility service, constantly extending their systems and increasing their investments coincident with the rapid increase of population, if no protection is given them from what are really destructive "shoe string" competitors or even competitors of the most powerful but piratical character.

Among the public utility service corporations, the gas company stands among the foremost as a desirable natural monopoly in any given district, and for the reason that is often not appreciated by many people, namely, to protect the public and upbuild the commonwealth.

The absurdity of having duplicate gas distributing systems, belonging to different separately operated companies, may be inferred from what has been said above From what will be shown later in actual figures, the fixed charges, independent of the amount of gas made or sold, represent a much larger portion of the cost of properly serving customers than will be found to exist in the conduct of the business of many other public service companies. The wide variations in gas rates in the different cities on the Pacific Coast show this conclusively. The quantity of gas made and sold from a single manufacturing plant is certainly one of the most important factors in determining gas rates.

It is a fact which cannot possibly be controverted that the cheapest possible gas rates may be perpetually maintained to the ultimate benefit of all parties concerned and with the greatest economy for all time, when the largest number of gas consumers are served from a single operating system, especially for distribution in any geographical district.

And it is also true that the larger the district served from a single manufacturing plant, as long as the average density of population using gas does not become too low, other conditions being the same, the lower may the gas rate be made and maintained continuously to the mutual advantage of both manufacturer and user.

Is it not inevitable that the false economy of dividing the total gas sales in a given district between two or more separate manufacturing and distributing companies is and always will be a burden that will be borne largely by the commonwealth, and tend toward the financial embarrassment of all, including gas companies and their consumers?

It must not be forgotten in connection with the above argument against unrestricted competition that it is assumed an able commission or other regulating body, wisely and with full knowledge based upon careful investigation, has complete control of the regulation of rates and quality of service of the one monopolistic gas company.

The so-called regulation of rates and service directly by inexperienced though well-intentioned municipal or county officials elected by the people. often for no other reason than their political affiliation or delightful, or otherwise, personal qualities, without any real understanding of the facts, is as absurd on the face of it as to entrust to the generous proportional Indian squaw of the Arizona desert the judging of the modishness and beautiful blending of delicate colors of the creations so dear to the civilized feminine heart, on exhibition, to the destruction of the masculine pocket-book, at our spring and fall fashion shows, or to leave to the untutored and lazy Apache, whose epicurean tastes are limited to Indian corn and tulapi, the planning of the banquet for this evening.

No decree or judgment can endure and be constructive rather than destructive in its effects upon humanity unless the judge, in rendering such decision, combines knowledge, experience, wisdom and justice.

HYDROELECTRIC PLANT AT PANAMA CANAL.

Operations have begun for the erection of the permanent hydroelectric station at the Spillway of Gatun Dam. Excavation for the turbine pits, close by the Spillway discharge channel, on the east side, has been carried to 5.25 feet below sea-level, over an area of 100 by 30 feet. The sheet steel penstocks are being assembled on the north toe of the Gatun Dam, near the spillway. The penstocks, of which there will be three, with provision for the installation of three more, if desired, will each be 10 feet 6 inches in diameter, of ⅜-inch steel, banded at intervals of three feet with 3-inch by ⅜-inch Z-bars, all set in concrete. The center of intakes will be at elevation plus 68.25, and their discharges into the turbines at elevation plus 27. When Gatun Lake is at its normal level of 85 feet above sea-level the effective head on the turbines will be 77 feet.

RECENT DEVELOPMENT IN DIESEL ENGINE APPLICATION.

BY J. W. WHITE, Jr.

While but fifteen years have elapsed since the first internal combustion engine operating upon the Diesel principle has been built, its present standing in the world of power, and its rapid commercial development indicate that the struggle for commercial supremacy between the steam power unit and the internal combustion engine is now being waged in earnest and present indications are favorable for the internal combustion engine.

The first Diesel engine was designed in 1893, and it is reported that it was expected to run on pulverized coal. The designer intended in its operation to apply the theory of the Carnot cycle to commercial practice. Actual developments did not bear out his original ideas, but the use of oil instead of powdered coal was found to be practicable, and from these experiments, the Diesel engine of today has been developed, so that at the present time a thermal efficiency of 41 per cent has been attained.

Types.

Commercial practice of the present day has called for the development of the Diesel engine in a number of types. Marine work calls for the cylinders in a vertical plane; while stationary practice, up to the present time has been more in the vertical than in the horizontal plane. Vertical engines so far have been built to operate on the four and two stroke cycle, but have not been commercially developed in the double acting type.

The advantage of the vertical type of engine is the smaller floor space required; while the head room is not a material disadvantage. It has the disadvantages, of more vibration, noisier operation, greater bearing strains, inaccessibility of parts, multiplicity of cylinders, bearings, etc., and its ultimate application will therefore be more particularly in marine work.

The horizontal engine has been built to operate on the four and two stroke cycle. The four cycle engines have been built in the single and twin tandem types, double acting, as well as in the single cylinder types, single acting, but within the writer's knowledge no two cycle engine has been built double acting.

The horizontal engine has the disadvantage of taking up greater floor space; while on the other hand, it gives better foundations, less vibration, quieter operation, and the possibility of a direct gear driven valve motion, which is simpler and quieter than the vertical type. In addition to the above, the piston pressures acting horizontally on the main bearings allow of a more perfect balance in the resultant forces of the moving parts, and this factor is desirable where heavy fly wheels are used.

The horizontal type, double acting, encourages the manufacture of much larger units, and eliminates the multiplicity of bearings which are objectionable in the vertical type.

The commercial development of the horizontal form will be most successful in the tandem type, because such construction permits the extension of the piston rod through the cylinder wall, allowing for its support between cylinders and on the piston extension. One distinct advantage of this construction is that it simplifies and makes commercially possible the cooling of piston and rods, and this of itself in the single acting engine materially restricts the size of the unit, and the horsepower per cylinder.

On account of the high temperatures in the cylinder the single acting engine in the horizontal form is more liable to develop scoring of the cylinder walls and lubrication troubles, while these disadvantages would be absent in the same engine built in the vertical plane.

Stroke Cycle.

There are a number of engines now being placed on the market, built on the two stroke cycle. Its some advantages include a smaller first cost, approximately 80 per cent reduction in weight, less floor space, and absence of exhaust valve. In the two stroke cycle engine, the ports are uncovered by the piston just before the end of the stroke. Its disadvantages are an increased fuel consumption of approximately 18 per cent due to the failure to thoroughly scavenge the cylinder; (2) Increased difficulty in cooling. Because the charge is fired twice as often as in the four stroke engine, there is approximately twice the amount of heat developed within the same area, which increases the necessary amount of cooling water while not permitting a decrease in the thickness of the cylinder walls.

The weight of the average two cycle; single acting engine in sizes from 300 h.p. up run approximately 175 lb. per h.p.; while the horizontal engine four cycle weighs approximately 280 lb. per h.p. The horizontal tandem, four cycle engine, which is built on the double acting type has been reduced in weight to approximately 230 lb. per h.p. In the vertical engines an average weight for the four cycle engine is approximately 150 lb. per h.p. as against 100 lb. per h.p. for the two cycle engine.

Compression.

In the Diesel engine a compression of 500 lb. is maintained with a consequent temperature of approximately 1000 degrees F. It is the endeavor of the designers of Diesel engines to burn the fuel charge at a constant temperature in the cylinder walls, and the probable initial temperature of combustion has been estimated at about 1400 degrees; while the exhaust gases issue at about a temperature of 600 degrees F.

Efficiency.

Average European practice shows a thermal efficiency of about 33 per cent, and as already stated, a maximum economy of about 41 per cent. The average distribution of the B.t.u. value of the fuel in an engine developing 33 per cent efficeincy is approximately as follows:

33 per cent developed power.
7 per cent overcoming mechanical losses.
27 per cent exhaust.
33 per cent jacket cooling.

It will be noted that the mechanical efficiency of Diesel engines is higher than that of any other internal combustion engine, one of the principal reasons being that for the same power output the friction load is smaller due to smaller cylinder diameters and stroke lengths. In addition, these losses are minimized in

the vertical engine, which up to the present time has been used more commercially than the horizontal type.

Horsepower Installed.

At the present time it is estimated by Dr. Diesel that 365 vessels have been equipped with the Diesel type of engine, and that the combined installations total approximately 100,000 h.p. No definite figures have been compiled on the total horsepower installed for stationary service. The largest marine engines built and in service are two engines of 1250 h.p., each operating on the Selandia, owned by the East Asiatic Company; the ship being of 7400 tons displacement. The successful operation of this boat has encouraged its owner to let contracts for two sister ships similarly equipped.

At the present time a boat now under construction is being equipped with two 2100 h.p. Diesel engines for the German American Oil Company, to be used in a 15,000 ton tank steamer. Both of these installations indicate that the limit of size in construction of Diesel engines is being rapidly expanded.

The largest stationary engine of which the writer knows is a 2000 h.p. twin tandem, four cycle, double acting engine, built by the Machinfalrick-Nuremberg, A. G., of 94 r.p.m., direct connected to alternating current generator, and installed in the lighting plant of the City of Halle, Germany, but at this writing there is building on the continent a 4,000 h.p. engine of twin tandem, double acting type.

Cylinder Capacities.

The natural practice in marine work would be toward a smaller ratio of diameter to stroke, and marine practice ranges from 1-1. to 1-1.5 with an average of 1-1.25. The largest cylinder sizes at present in operation are 12 in. in diameter by 20 in. stroke at 140 r.p.m., i.e.: 150 h.p. per cylinder, and operating on the four stroke cycle. Present indications are that cylinders built in units of 250 h.p. each for marine work will be developed shortly. The largest cylinder capacities in the stationary engines at the present time are 500 h.p. per cylinder; same being of the four cycle, double acting type. There are under construction, however, engines having cylinder capacities of 1000 h.p. per cylinder, being four cycle double acting.

Stationary cylinder ratios are greater than in marine practice to give lower rotative speeds, a better cooling. The amount of cooling water increases as the square of the diameter and the cube of the volume. It is therefore evident that a long stroke will give lower first cost, thinner cylinder walls, and less cooling water per unit of power.

Stationary cylinder ratios vary between 1-1.4 to 1-1.5 in both the two and four cycle engines.

American vs. German Practice.

The thermal efficiency reached by American manufacturers is considerably lower than that obtained on the continent, and there are a number of reasons why higher economies are not obtained.

The German mechanic is of higher grade than the American mechanic, and gets paid a much smaller wage. He is domestic, and specializes on one type of work, and it is customary for German mechanics to live and die in the employ of one company, unless pensioned. German foundry practice has been developed to a much higher degree abroad than in the United States, which explains why the German engines are not troubled with cylinder cracking from temperature strains, when this same trouble is the principal one experience with American engines.

American practice places the exhaust ports on the side walls of the cylinder because of the difficulties experienced in casting them in the cylinder head. From the foundryman's point of view in Germany, the casting of the cylinder head now presents no difficulty. Before the best process and mixture were found, the fact was developed that it was not essential to have only the closest and densest blends. It was proved that the best results were obtained with ordinary iron, such as is used for steam engine cylinders. All that is required is to use special care during casting to keep the liquid iron in constant motion until poured, so that the iron may be uniform in texture and homogeneous.

There are several radical differences between the construction of the German and American engines.

In the German engines a screened intake port is used to prevent any foreign matter from entering the cylinder, and this feature, more than any other, probably explains why the German engines are not scored in the cylinder walls, and have so little trouble in lubrication.

In mounting the valves on the engine, it is German practice to place them in the cylinder head, all mechanically operated by levers instead of spring operated valves of the poppet type. Positive actuation of these valves is a marked superiority and prevents leaky ports, due to the fact that the valves are mechanically seated under pressure. On the cylinder head are mounted the exhaust, intake, oil injection, and compressed air ports.

Another marked difference in the construction is that the oil spray is screened for dirt, and is of the multiple port type, making the fuel injection much more perfect than American practice, where it is most often done with a single jet.

In German engines, the air compressor is driven from a bell crank, which cuts out all possible mechanical back lash. Governing is obtained by varying the port opening in the suction of the oil pump: this port being held open by governor action, so that the volumetric displacement of the oil pump varies with the timing of the suction port closing.

In American built engines, the air inlet is usually of the spring poppet type, so that the valves do not open mechanically at a predetermined time, but depend on a minus pressure in the cylinder itself, and therefore, like air compressors equipped with poppet valve intake ports, the volumetric efficiency is much lower than with the mechanically operated valve. A valve of this type necessarily has very weak springs, which give poor seating, and therefore dirt accumulating on the seat of the valve causes leaking at this point. This, together with the fact that the air is not screened at the intake, is one of the most serious defects in the operation of the American built Diesel engine, as it gives poor combustion and smudgy cylinder walls, with leaky valves and dirty cylinders.

Another bad feature in American design is that the valves are crowded together on one side of the cylinder, the intake and exhaust ports being directly above each other, so that the hot gases and the fresh charge of cold air both pass the same point; thus increasing liability of cracked cylinders.

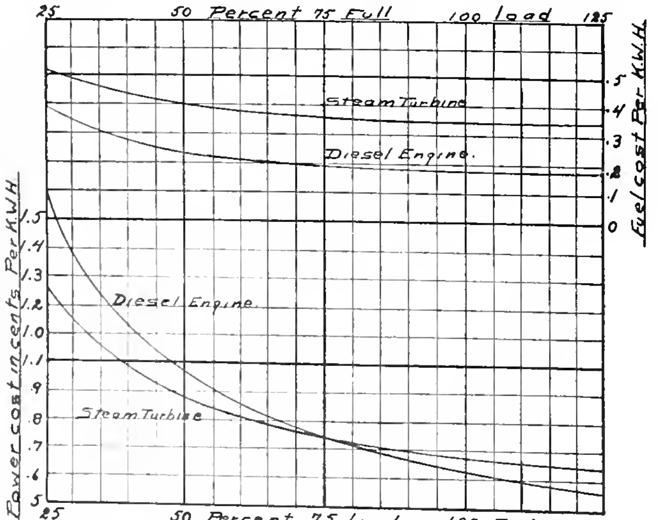
The result is that the average efficiency of American built engines is about 29: while that of the German engines is about 33 to 35 per cent.

Application to California Practice.

On account of the fact that California crude oil runs so high in asphaltum, it is necessary to bring up the compression of the Diesel type of engine to 700 or 800 lb. before oils of 18 gravity can be successfully burned in the cylinder direct. This pressure seems to be beyond good commercial practice, and therefore, engines of this type, with but few exceptions, are not guaranteed to burn oil of lower than 22 gravity, so that in power plants where both steam and Diesel engines could be used, two separate oil supplies are necessary.

In Germany and through continental countries, the price of labor and station attendance is low, interest on money invested from 2 to 3 per cent, there is a scarcity of coal, and the price of fuel oil is high, all of which is favorable to the application of the Diesel engine to central station service particularly. On the Pacific Coast, the price of labor and attendance is high, the price of oil extremely low, interest on money high in comparison, together with the fact that central station service on the Pacific Coast has usually a much smaller load factor than abroad, and therefore, its use in central station service will be confined to carrying the day load, and getting as nearly as possible continuous operation.

Figuring oil at 60 cents per barrel for a steam plant, and 22 gravity oil suitable for Diesel use at 85 cents per barrel, and figuring interest, depreciation, and the setting by of a sinking fund at 15 per cent and making average charges for fuel, station attendance, lubrication, etc., it will be found that the total power cost curve of a Diesel engine operating in a station containing 1000 kw. of this class of prime mover will cross the economy curve of a steam plant of the same size, equipped with two steam turbines at approximately 70 to 75 per cent load factor. These results are



Comparison of Diesel Engine and Steam Turbine.

shown in curve herewith, where the Diesel engine is given credit for 11.2 kw. hours per gallon of 22 gravity oil, while the steam plant is given credit for 4.2 kw. hours per gallon of crude California oil. Cost of the steam plant is figured at $80 per kw. installed; while the cost of the Diesel is figured at $150 per kw. installed. It is believed that these figures represent average central station practice.

Few central stations have a load factor above 40 per cent. The majority average between 33 to 37 per cent. A careful examination of most central station plants on the Pacific Coast indicates that about 33 per cent of the peak load would be the largest capacity allowable for Diesel engines operating in conjunction with steam turbines on a central station load; while if it were desired to install a Diesel engine in central station service for continuous operation (i.e.: 100 per cent load factor), the average central station load on Pacific Coast would not allow Diesel capacity in excess of 15 per cent of the total peak.

For marine service on this coast, the Diesel engine should find a fairly good field on account of the fact that in propelling ships a high load factor is obtained, its lighter weight gives the vessel increased tonnage capacity, its greatly reduced fuel consumption and displacement gives the vessel a greater steaming radius, all of which contribute to its saving and earning power to a much greater degree than its relative advantages as applied to saving in central station service.

THE SOCIETY FOR ELECTRICAL DEVELOPMENT, INC.

At the third meeting of the organization committee of the Society for Electrical Development, Inc., at New York, on October 18, the by-laws were approved as a whole, including the article referring to the basis of financing, which is to the effect that the funds to advance the purposes of the society will be subscribed by its members on the following basis: Central station and manufacturing members, not less than one-fifteenth of 1 per cent on the gross amount of their respective sales up to and including $20,000,000, and at the rate of not less than one-twentieth of 1 per cent on the gross amount of such sales in excess of $20,000,000; the contracting, dealing and jobbing members, not less than one-twentieth of 1 per cent on the gross amount of their respective sales.

The board of directors will be composed of five classes (the board having twenty members), four from the central station interests, four from the manufacturing interests, four from the jobbing interests, four from the contracting interests and four at large. These directors will each be elected by the membership represented in the class in which they belong, with the exception of the members at large, who will be elected by the membership as a whole.

Committees were appointed to lay out definite plans for the further financing of the society, and also to lay out plans relative to its policy and the work which it expects to carry out, so that with the election of officers at its next meeting and probable approval of general plans, the society can well be said to be under strong headway after many months of hard work. The meeting will be held on November 18 in New York City.

LEGISLATION VS. REGULATION IN ELECTRICAL DISTRIBUTION.[1]

BY J. E. MACDONALD.

The 1911 session of the California legislature added to the laws of that state over 800 statutes. This is a remarkable record, when one considers the amount of labor involved in drafting and redrafting these measures in committee, before final submission to legislature and senate for acceptance or rejection.

Those of us who are wont to criticise legislative measures should consider carefully the great amount of technical knowledge and sound judgment required to intelligently pass on matters which may be burdensome to a few while at the same time seeking to safeguard the interests of the multitude.

Those associated with public utilities have been very much interested in Chapters 499 and 500 of the 1911 regular session, known as the overhead and underground laws; and Chapter 14 of the extra session, otherwise known as the Public Utilities Act. The former seek, by means of legislative action, the control of all overhead and underground construction, whereas the Public Utilities Act delegates to the Railroad Commission unlimited power over every phase of overhead and underground distribution.

The overhead and underground laws have been in effect since October 22, 1911, whereas the Public Utilities Act has been effective since March 23rd of the present year, and little opportunity has been afforded to observe its bearing on distribution problems. The recent activity of the Railroad Commission, however, as displayed in proposed General Order No. 26, which covers its investigation concerning overhead crossing conditions, furnishes direct evidence that the policy of the Commission is constructive.

It should be noted that the underground law is most reasonable. In two of its most important sections it provides an exception as follows: "Shall not be held to apply where satisfactory proof shall be submitted to the proper authorities, that it is impracticable or physically impossible to comply with this law within the space or location so designated by the proper municipal authorities."

This analysis, therefore, will be confined largely to the overhead law, which has created a great deal of unfavorable criticism. The important provisions of this law may be summarized briefly as follows: (1) provision requiring 13-inch clearance between any wire and center of any pole; (2) provision requiring 4-foot vertical clearance between wires carrying electricity at voltage exceeding 600 and those carrying electricity at voltage less than 600; (3) requirement demanding that crossarms be painted yellow for wires carrying more than 600 volts, or the use of "High Voltage" signs in lieu thereof; (4) provision prescribing manner of placing guys; (5) provision requiring insulation of lateral pipes from overhead to underground; (6) provision prohibiting placing a transformer and arc lamp on the same pole; (7) provision specifying type of construction at high-tension crossings with other lines; (8) provision for installation of safety bolts and clamps for supporting telephone cable; (9) provision regulating manner of placing insulation in railway span wires.

[1]Paper presented before Los Angeles Section, A. I. E. E., October 29, 1912.

Fig. (1) shows the most important of these requirements.

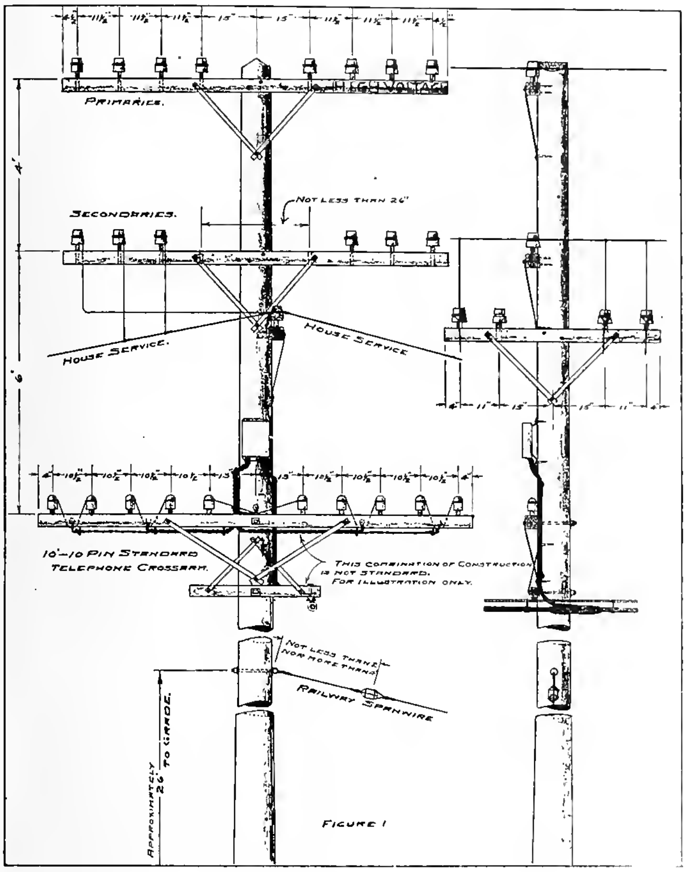


Fig. 1. Illustration of Principal Requirements for Overhead Construction.

Paragraph (a) demands that a clearance of 13 inches be maintained between any wire and center of any pole. This has long been a standard for most telephone companies, exceptions being made in special cases to conform to good engineering principles. Most lighting companies have voluntarily increased this distance to 15 inches, giving a clear climbing space of 30 inches, as compared to 26 inches provided by the law. Exceptions under the provisions governing this 13-inch clearance are as follows:

> "Provided, that the foregoing provisions of this paragraph (a) shall be held not to apply to telephone, telegraph or other 'signal' wires or cables which are attached to a pole to which is attached no wire or cable other than telephone, telegraph or other 'signal' wire or cable, except within the corporate limits of any city or town which shall have been incorporated as a municipality, nor shall the foregoing provisions be held to apply to such wires or cables in cases where the same are run from underground and placed vertically on poles, nor to 'bridle' or 'jumper' wires on any pole which are attached to telephone, telegraph or other 'signal' wires on the same pole, nor to any 'aerial' cable, as between such cable and any pole on which it originates or terminates, nor to wires run from 'lead' wires to arc lamps or to transformers placed upon poles, nor to any wire or cable where the same is attached to the top of a pole, as between it and the said pole, nor to any 'aerial' cable containing telephone, telegraph and other 'signal' wires where the same is attached to a pole on which no other wires or cables than wires continuing from said cable are maintained; provided, that electric light or power wires or cables are in no case maintained on the same side of the street or highway on which said 'aerial' cable is placed."

In indicating these exceptions it was, no doubt, intended to provide for the safety of employes of the wire-using companies. They are based, however, on the assumption that the companies are not able to determine proper spacing of wires on pole, and yet are quite competent to decide on the finer points of construction, such as the erection of transformers, arc or incandescent lamps and other fixtures. Mechanically it is better to attach a telephone cable direct to the side of a pole than to place it on a cable crossarm, as demanded in combination construction outside municipalities, and in all construction within municipalities. The electrical hazard is present in either case, and may be minimized by providing proper clearance between the telephone cable and contiguous high voltage wires. The effective climbing space need not be materially lessened if, when a second cable in installed, it is placed on the same side of pole with first cable. This is shown in perspective in Fig. (2). Again, the

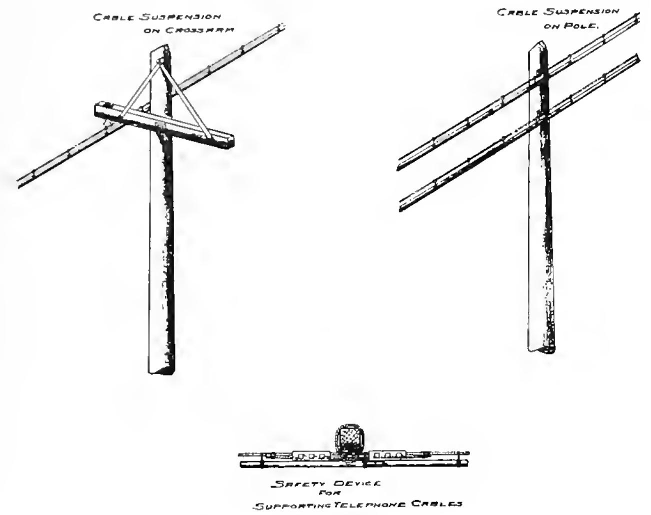


Fig. 2. Recommendation for Telephone Cable Suspension.

13-inch clearance should not be necessary on the toll circuits of the telephone companies. These are never placed in the same location with circuits carrying high voltage if it can be avoided. This involves more than a mere difference of opinion. Certain well-fixed standards, based on correct transposition and spacing of wires, have been established for the production of needed effects. It has not been shown that the electrical hazard has been affected by the maintenance of these standards. The 13-inch clearance is therefore essential as a standard, but some further exemptions from its applications are desirable.

Fig. (3) shows one very good method of mounting one or two transformers on pole and connecting same to line properly, but as far as the "lead" or "jumper" wires are concerned, there is no suggestion as to the correct method of installation, so that they may not be a menace to life and property. The same applies in the exception for "lead" wires to arc lamps. Fig. (4) shows a standard method of suspending an arc lamp, and provided the line wires are erected so as to comply with the law, the "lead" wires may be installed in any manner to suit the constructing company.

Fig. (5) shows a common type of construction in Southern California, being a telephone line and street lighting circuit on a combination pole. This is recognized as being absolutely safe. This method is within the law, but it should be noted that such construction, if not installed properly, would create a dangerous condition.

There is nothing in the law specifying the manner of erecting and maintaining of "bridle" wires, and it would require skillful, logical treatment to express this properly in concrete terms without the aid of a drawing. These are shown correctly in Fig. (1).

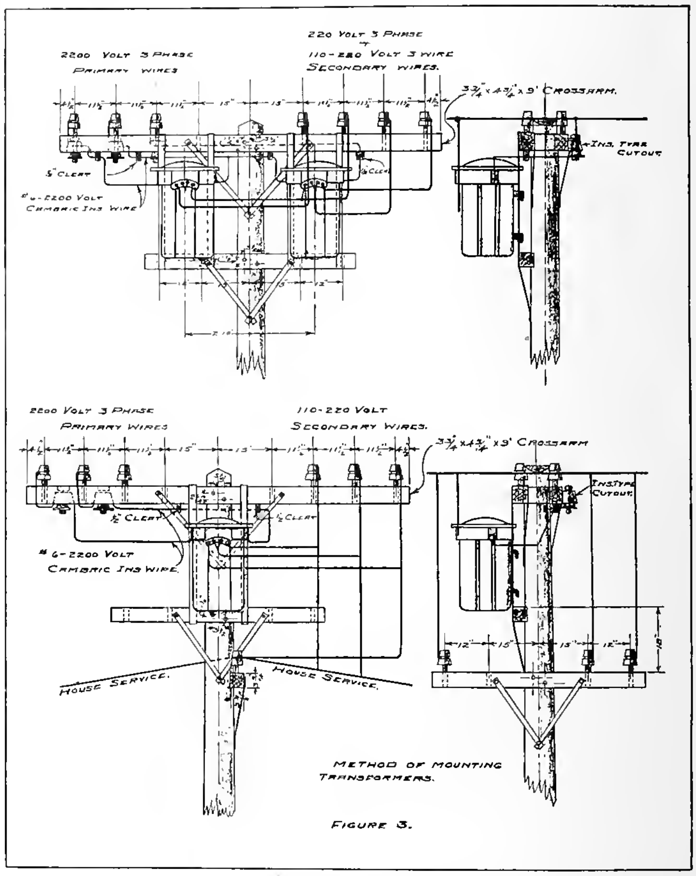


Fig. 3. Excellent Method of Mounting and Connecting Pole Transformers.

Paragraph (b) is similar to paragraph (a), but provides that 13-inch clearance must be maintained from wire to center of pole, as applied to poles and wires erected in an existing lead. This is an excellent provision when coupled with the modifications suggested for paragraph (a). It should be noted that in all cases it.is permitted to erect poles and wires for reconstruction on joint poles, and it has been conceded that such poles and wires are not in violation of the law during reconstruction.

Paragraph (c) is the most radical provision of the entire law, and refers principally to the 4-foot clearance demanded between wires carrying over 600 volts and wires carrying less than 600 volts. It is desired to quote this paragraph in full, as follows:

"Run, place, erect or maintain, above ground, within the distance of four (4) feet from any wire or cable conducting or carrying less than six hundred volts of electricity, any wire or cable which shall conduct or carry at any one time more than six hundred volts of electricity, or run, place, erect or maintain within the distance of four (4) feet from any wire or cable which shall conduct or carry at any one time more

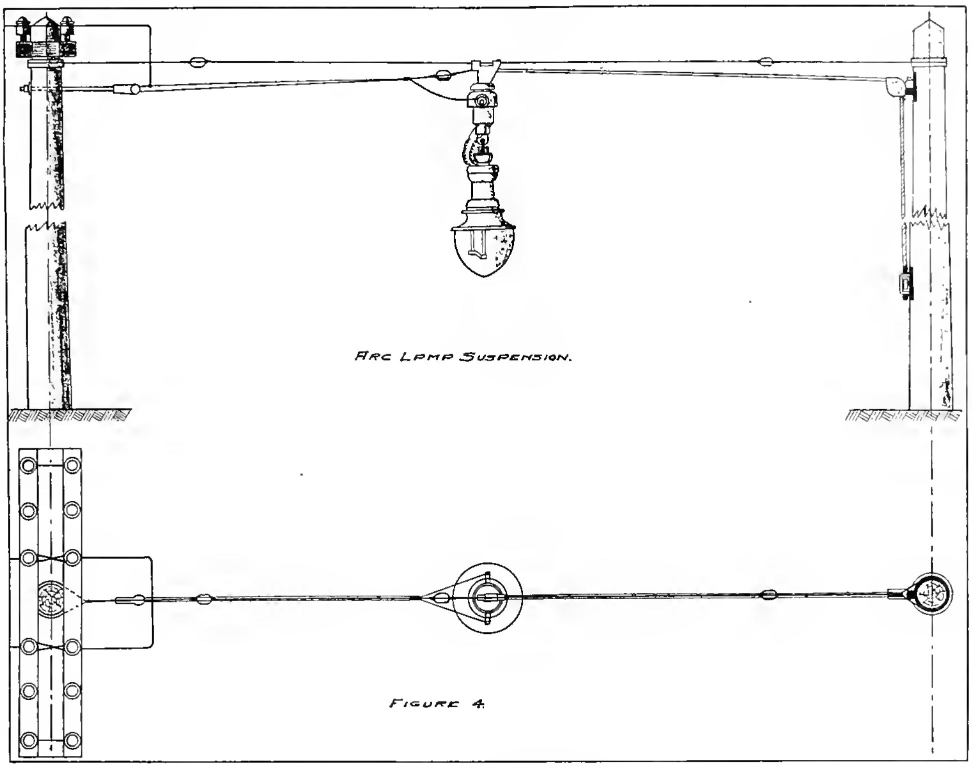


Fig. 4. Standard Method of Arc Lamp Suspension.

than six hundred volts of electricity any wire or cable conducting or carrying less than six hundred volts of electricity; provided, that the foregoing provisions of this paragraph (c) shall be held not to apply to any wires or cables attached to a transformer, within a distance of four (4) feet (measured along the line of said wire or cable) from the point where such wire or cable is attached to such transformer, nor to wires or cables within buildings or other structures, nor to wires or cables where the same are run from underground and placed vertically on poles, nor to any 'lead' wires or cables between the point where the same are made to leave any pole for the purpose of entering any building or other structure, and the point at which they are made to enter such building or structure, and, provided further, that as between any two wires or cables, or any wire or cable run, placed, erected or maintained in violation of the provisions of this paragraph (c), only the wire or cable last in point of time run, placed or erected shall be held to be run, placed, erected or maintained thus in violation of said provision; and further provided, that where no more than one crossarm is maintained on a pole, all the wires or cables conducting or carrying at any one time more than six hundred volts of electricity shall be placed on the crossarm on one side of the pole, and all the wires or cables conducting or carrying less than six hundred volts of electricity shall be placed on the crossarm on the other side of the pole; and further provided, that the space between any wire or cable carrying or conducting at any one time more than six hundred volts of electricity and any wire or cable carrying less than said voltage shall be at least thirty-six (36) inches clear measurement in a horizontal line; and further provided, that where two or more systems for the distribution of electric light or power occupy the same poles with wires or cables, all wires or cables conducting or carrying at any one time more than six hundred volts of electricity shall be placed on the crossarm on one side of the pole, and all wires or cables conducting or carrying less than said voltage shall in such cases be placed on the crossarm on the other side of the pole; and further provided, that the space between any wire or cable conducting or carrying at any one time more than six hundred volts of electricity and any wire or cable conducting or carrying less than said voltage shall be at least thirty-six (36) inches in measurement in a horizontal line; and further provided, that in such construction all crossarms shall be at least thirty-six (36) inches apart in a vertical line."

It will be noted that modifications have been made to provide for joint pole construction; further, it permits the maintenance of wires carrying more than 600 volts on the same crossarm with wires carrying less

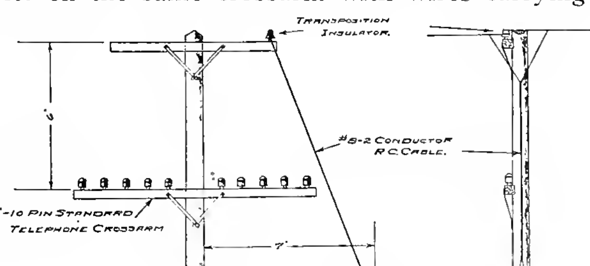


Fig. 5. Series Street Lighting Circuit and Telephone Line on Combination Pole.

than 600 volts, provided high and low voltage wires are maintained at least three feet apart in a horizontal line. In combination construction it is apparently compulsory for companies to maintain all primary wires on one side of a pole and all secondary wires on the other side of the pole. This creates a serious

complication, especially where one company desires to maintain twenty-four primary and high voltage street lighting wires and only three secondaries. Further, if one company adopts standard construction, giving the regulation 4-foot clearance between high and low voltage wires, there is doubt as to whether it is compulsory for the first party to reduce clearance to comply with the 36-inch provision when second party desires to make combination. Some further doubt exists as to what constitutes a distributing company. In giving this paragraph the interpretation implied it is compulsory to modify construction for circuits of the same voltage in a manner which is made to depend upon the ownership of the wires and crossarms. Has this anything to do with the hazard involved? In this respect, the safe course to follow is that of adopting the maximum 4-foot clearance in all cases, and thus avoid contingencies which might arise from an improper interpretation. Again, if it is necessary, in combination work referred to, to place high voltage wires on crossarm on one side of the pole and low voltage wires on the crossarm on the other side, it may be assumed that a company would be within the law in placing telephone lines on the same crossarm with high voltage circuit. Further, there is but one classification for high voltage wires, viz., those carrying electricity at more than 600 volts. This classification admits of great improvement.

With reference to buckarming or leading off from a circuit at crossing or elsewhere, it should be noted that exception has been made for service wires, which may be installed in any manner to suit the operating company, yet, when it is necessary to "buck," it is compulsory to maintain at least four feet between wires carrying more than 600 volts of electricity and wires carrying less than 600 volts. Thus it is necessary to place line arms at least eight feet apart, and in combination work this introduces a serious condition at corners where, even with high poles, serious congestion results. The wording of this paragraph is most unfortunate. If this could be amended so as to provide for rational construction, it would go far toward overcoming the numerous criticisms that have been advanced against the statute. Fig. (6) shows buckarm construction with primaries and secondaries on the same arm, and with but two feet clearance where lines cross each other. This should be permitted.

Paragraph (d) provides that crossarms which are used for supporting wires carrying more than 600 volts of electricity shall be painted yellow, in lieu of which it is permitted to place on crossarms an enameled iron sign, providing, in white letters on a green background, the words, "High Voltage," these letters to be not less than three inches in height. These provisions are quite specific, and either of them provide a questionable measure of safety to employes of the operating companies. It is good practice to consider all wires "alive," and the employe who does not know the normal voltage of line upon which he is called upon to work, or who fails to determine this voltage for himself, is not likely to be protected in any great degree by yellow crossarms or any other device designed to think for one engaged in so hazardous an occupation.

Paragraph (e) relates to guy wires and guy cables, and provides that all guy wires and guy cables shall be effectively insulated at all times at a distance of not less than 4 feet nor more than 8 feet (measured along the line of said wire or cable) from the upper end thereof, and at a point not less than 8 feet vertically above the ground from the lower end thereof. This is an excellent provision. A further requirement, providing that two or more guy wires or guy cables attached to a pole must be at least one foot apart, in a vertical direction, between points of attachment, is correct, provided such guys are run to a common anchor. There are cases, however, where there are two or more anchors, and in such cases the 1-foot vertical spacing is not good construction; neither is it necessary or desirable to place insulators in guys which are attached to steel poles or towers when same are known to be well grounded.

Paragraph (f) provides that any wires or cables used to conduct electricity and erected or maintained vertically on pole, shall be wholly encased in casing equal in durability and insulating efficiency to a wooden casing not less than 1½ inches thick. The custom heretofore has been to insulate such wires and cables from the point of attachment to line down to a point approximately 6 feet below the lowest crossarm, the object being to protect the lineman from coming in contact with iron pipe with which such cables are frequently enclosed, a thorough ground being established at all times. The chances for accident due to pipe not being protected from a point 6 feet below lowest crossarm or cable are extremely remote. As the intent of the law, however, is to protect life, it is well to concede that this provision is worthy of adoption. Instead of using wood, it is common practice to use fiber conduit, which at once provides a medium for insulation and protection of the conductor contained therein.

Paragraph (g) prohibits the placing of an arc lamp and a transformer on the same pole. This is a correct provision, but should not apply to arc lamps which are not trimmed from pole provided that, in other respects, proper clearance has been established.

Paragraph (h) considers certain phases of the high-tension crossing problem. There are two important provisions in this paragraph: one providing for the high-pole short-span construction at crossings, which is applicable on private rights of way, but limited in its uses elsewhere, and the other consists of a "double-strength construction" scheme. In the rapid development of high-tension work, many companies are providing construction which is as safe as engineering ingenuity may devise. The term "double-strength construction," as applied to such transmission lines, is too general to be effective. There are many communities where high-tension lines are maintained, and these lines cross other circuits and services at frequent intervals. The application of the "double-strength construction" theory implies that it is necessary in such cases to double up on the prevailing factors of safety without any consideration of the hazard involved. This feature alone has forced a number of companies to the use of No. 0000 wire, at which the "double-strength" construction requirement ceases to apply.

Paragraph (i) is as follows:

"Run, place, erect or maintain any suspension wire to which is attached any 'aerial' cable of '75 pair number nineteen, Brown and Sharpe gauge,' or over, or of '100 pair number twenty-two, Brown and Sharpe gauge, or over, suspended from a crossarm (or from any other structure or appliance from which said suspension wire is hung), by a single bolt and clamp without at the same time attaching said suspension wire to said crossarm, structure or appliance by an additional 'safety' bolt and clamp (or other 'safety' appliance for thus attaching said suspension wire) of tensile strength equal to the first herein said bolt and clamp."

A careful examination of the methods adopted to comply with this provision shows that it has introduced extra elements or fixtures, any part of which is not stronger than the single bolt and clamp used heretofore. A careful study of this provision makes it particularly evident that considerable extra work has been provided for without any increase in safety. It has been the practice heretofore to "strain guy" the messenger on curves or corners, which amply provides for the condition implied in this paragraph. Fig. (6)

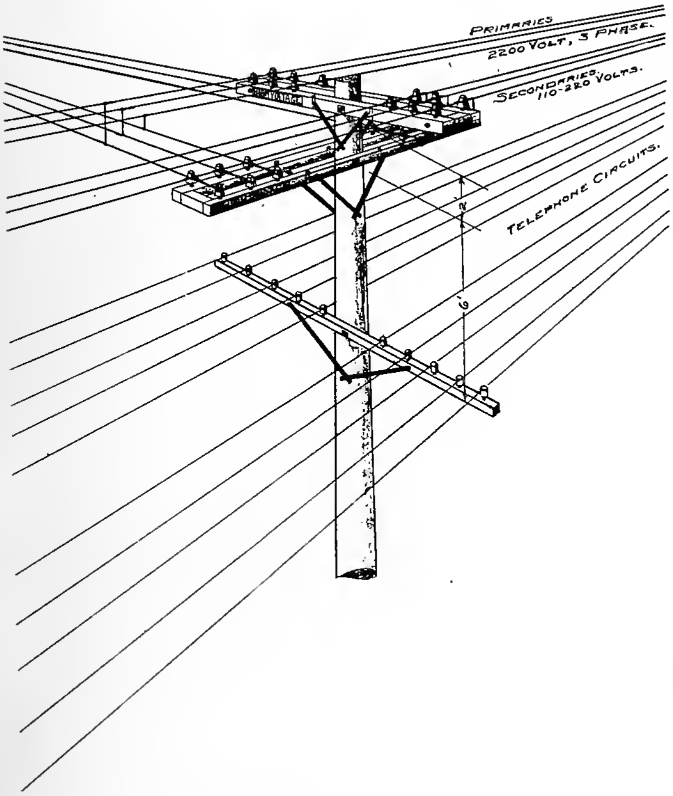


Fig. 6. Proposed Buck Arm Construction

shows one of the best methods of complying with the law, and consists of two three-bolt clamps and strand wire loop around crossarm.

Section (2) exempts from all previous regulations, except the 13-inch clearance from wire to center of pole, all "direct current" electric wires or cables having the same polarity, and "signal" wires, when not more than two such "signal" wires are attached to the same pole. This provides for maintenance of railway feeders and telephone or "signal" wires, but is not clear as to its exact intent. The paragraph reads as if all "direct-current" wires are exempt, but it is not probable that such an interpretation was intended.

Section (3) provides that insulation must be placed in trolley span wire at a distance not less than 2 feet nor more than 4 feet from point at which span wire is attached to the pole, which agrees with good practice. But it further provides that span wires on double-track electric lines must have an insulator in same when these trolleys are more than 10 feet apart. The minimum distance between centers for even narrow-gauge double-track electric lines in Southern California is 11 feet 6 inches. This exception, therefore, provides for a condition which does not exist.

The net result of one year's operation in Los Angeles has been to increase the cost of construction about ten per cent. This increase is made up of a charge for longer poles and the cost of bringing lines up to standard, whenever it is necessary to make any change in overhead.

It has demonstrated fully that all retroactive features of the law should be eliminated. In the natural order of reconstruction and maintenance all obsolete construction is rapidly disappearing, but even considering this, a sum well above one-half million dollars will have to be appropriated by Los Angeles companies to complete the reconstruction in the five-year period allowed for such work. It seems that this is a needless expense and one for which there is no compensation.

It is but natural that we should now consider the possibilities of the immediate future. The Public Utilities Act is recognized as one of the most important results of the present administration. It does not seem probable that the legislature responsible for such a comprehensive measure would be adverse to taking such action as would do away with the confusion now existing as to the overhead law. There is no doubt but that employer and employee would both be glad to see the matter reopened.

In the light of the knowledge gained during the past year, it should be possible to reduce overhead distribution to a real art. Efficient regulation of electrical distribution is a much-desired possibility. The most beneficient legislation may fail in its purpose when not only lawyers, but engineers as well, disagree as to its application.

STATISTICS IN ELECTRICAL INDUSTRY.

Statistics published in a recent British Foreign Office report show that during 1911 the total value of electrical goods exported from Germany amounted to $52,558,000, which shows no increase, and that the imports amounted to $11,436,000, a rise from $7,056,450. The exports of electrical machinery and appliances from the United States during last year were worth, in round figures, about $19,329,000, as against $16,547,300 in 1910. In regard to Great Britain, last year's exports comprised $13,720,000 worth of electrical goods and apparatus, $8,714,500 worth of electrical machinery, and $254,500 worth of electrical porcelain ware, a total of $22,689,000. The imports under these classifications were valued at $6,986,000, $5,114,000, and $191,000, a total of $12,291,000. For 1910 the British totals were: Exports, $28,246,000; imports, $11,217,285.

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CONTENTS

The Dovetailing of the Steam Auxiliary

In making studies relative to the determination of the point of economical generation in a central station system having both steam and hydraulic plants, it is evident that as the amount of water storage available plays the most important role, the use of this storage should be given the greatest consideration.

The determination of just what load the steam plants should carry depends on the stream flow available, the peak demand, and the extent of storage to the end that no water is wasted. If this storage can be brought about in the early morning hours while the low daily load is on and the pondage thus obtained is capable of taking care of the peak period, then of course steam power is not required. On the other hand, a recent committee report of the Northwest Electric Light & Power Association states that actual cost data have been obtained from a system that previously used its steam plant to take care of the peaks, but which has for the past two years utilized its hydraulic plants to handle the fluctuations, at the same time maintaining a constant load upon the steam plant. Such operation shows an increase in the average kw.-hr. production per gallon of oil from 2.5 to 4.5 and better.

It is well-known that the best results from steam plant generation are obtained when the plant is operated at or near unity load factor. This also holds true for individual generating units in a steam plant. Hence the suggested saving to be obtained by maintaining a constant, properly dovetailed load upon the steam plant in a hydroelectric net-work is indeed worthy of the most earnest consideration.

Legislation vs. Regulation

The California legislature of 1911 enacted over 800 new laws for that commonwealth. A person unfamiliar with the routine necessary in trimming and revising proposed statutes cannot appreciate the tremendous work necessitated in bringing into life such a record-breaking number of new enactments. Many of these laws are proving themselves worthy of the progressive sentiment which dominated the legislative body of that year. Two of these statutes, No. 499 and 500, have, however, proved unquestionably their inefficiency and unjustness. A complete analysis of these two statutes may be found on another page of this issue.

Under statute No. 499, power companies are put to endless expense, for the enactments are retroactive. If danger to life or property was shown to be avoided, at least some excuse could be given to warrant this wanton waste of money. J. E. Macdonald points out clearly in his analysis that this cannot be accomplished under the present statute.

It is fortunate indeed that the Public Utilities Act, put into effect March 23, 1912, gives full power to the Railroad Commission to bring relief. In its general order No. 26, the commission, acting under its lawful authority, clearly shows that it is dominated by a constructive policy which means much for the future of overhead construction.

It is a source of congratulation, too, that the commission is empowered to act in the matter, for even under the most perfectly drawn law, the march of

invention necessitates constant changes. What is safe and desirable today may be wholly and justly avoided tomorrow. A regulating commission with its corps of experts, keeping abreast of the times, offers an elasticity in proper supervision of overhead construction not to be accomplished by even the most carefully and precisely drawn laws.

Irrigation Facts Important to Electrical Engineers

Scarcely a half dozen years have past since the full realization of the necessity for irrigation throughout practically the entire West. Even those districts which boast abundant mean annual rainfall no longer scoff at the irrigation enthusiast. Countless recent installations emphasize this. As instances, examine the Rogue River Valley and the Willamette Valley of western Oregon, and, indeed, the most productive portions of the Sacramento Valley in California where a few years ago to suggest the possibilities of irrigation was to insult the land owner.

If conclusions such as these are to be drawn from well-watered valleys, what then, is to be said of the remaining vast acreages of the West considered in the past as properly supplied by nature? Only one answer is possible. This answer is silently but impressively making itself felt in the connected daily loads of Western hydroelectric companies. On all sides the irrigation power expert is to be found arguing with the intelligent farmer. Thousands of new electrical pumping installations made during the past year instance the fact that the modern farmer is ready to make any reasonable move to insure continuity of crops and larger return per season from his holdings. Enquire into this growth of connected load and note the findings. Of the three larger companies of California, each at present have a connected pumping load of 25,000 h.p. or over, operating units of from 10 to 20 h.p. Reports from Oregon indicate even greater service in the rural communities. In the other states of the West, conditions are still more emphatic in proportion to the present development. This remarkable progress is but a beginning. Upon estimating the possibilities of utilizing electric power profitably upon irrigable lands of the West, one is almost overcome with its gigantic proportions.

But not alone for the actual pumping load acquired is the rural community valuable. Experience has well proven that the farmer once educated to use the electrically operated pump soon finds countless other applications in his home and about the farm. The farm house, the barn and the bunkhouse soon become electrically lighted. The dairy, too, feels the impetus of modern invention for electrically driven milkers, are fast coming into use. About the farm the electric truck finds its place in the necessary haulage of crops to the market. Finally, that climax of modern comfort and luxury, the limousine, soon is seen taking the farmer and his family upon their outings. The psychological effect, then, of the electrically operated pump sweeps all before it.

Hence, so far as the electrical engineer and the power expert are concerned, this pointing of the index finger in Western progress means but one thing. If they are to be in the running, a comprehensive knowledge of irrigation and its applications are imperative. No longer is the running-broad-jump method of computation to be tolerated. Competition has reduced the issue to a hair-breadth. Often, indeed, an extremely profitable load may be secured if the sales engineer is able to take into account all the favorable features of soil, rainfall, duty of water and other niceties which vary in each community. Knowledge, then, relative to irrigation and its various ramifications is an indispensable asset for the successful Western power engineer.

Knowledge relative to irrigation has but intermittently found its way into the technical press concerned with affairs electrical. Due to the continued and widespread interest of our readers in the ever-growing applications of hydroelectric energy, the Journal, with this issue, takes pleasure in making an important announcement to its readers. Our leading article, contributed by Professor Bernard A. Etcheverry, heralds the beginning of one of the most interesting and profitable series ever undertaken by our editorial force. A continuation of this article in separate and distinct form, yet complete as an entire unit, will appear in succeeding issues. Under a departmental heading, entitled "Electric Pumping and Irrigation," every phase of this subject will be treated, while the matter contained will be largely technical, it is believed that the mathematics employed will not be too severe for a comprehensive grasp of the points discussed.

The great fault usually met with in a series of articles arises from the fact that the busy reader, unable to follow each article as it appears, becomes entangled in a mass of deductions, hinging upon conclusions previously brought out in some article he overlooked. Hence the remaining articles are cast aside as utterly useless reading. In this series each article will be complete in itself. Though general references are at times made to preceding deductions, a reading knowledge is acquired by following the discussion brought out in each separate unit. In a word each article may be understandingly and profitably read without any consideration of its predecessors.

It is seldom our columns have had contributions from one so well qualified to handle his subject. Mr. Etcheverry graduated from the University of California as medallist of his class. As an Associate Professor of Irrigation at the University of Nevada, he gained valuable experience in the surrounding arid community. Some years later, returning to his own university to undertake work in irrigation begun by the eminent irrigation expert, Elwood Meade, he soon built up, as head of the Department of Irrigation, a literature upon Western methods and practice in irrigation not hitherto accomplished. Personal visits of inspection and expert consultation in all parts of California and the Nortwest have made him an authority on Western irrigation practice. It is not surprising, then, that during the current year, in addition to his connection with the federal government as irrigation expert in the department of agriculture, he should be asked by the authorities in the Province of British Columbia to make a comprehensive compilation on practical information relating to irrigation for that province. This report has recently made its appearance in bulletin form under authority of the legislative assembly of British Columbia.

PERSONALS.

Bion J. Arnold is at San Franicsco.

M. H. Sherman, a director of the Pacific Electric Railway, has returned to Los Angeles from a trip around the world.

H. W. Beecher, Northwest manager for Chas. C. Moore & Company, has returned to Seattle from a brief visit to California.

J. P. Bowden, who is president of a Canadian electrical appliance firm, is a recent arrival at San Francisco from Toronto.

F. H. Leggett, manager of the Western Electric Company's Pacific Coast department, has just returned to his headquarters at San Francisco after visiting Los Angeles.

K. Archer, of Paris, who is connected with a Dutch Company manufacturing oil engines of the Diesel type, which are in use on large European steamers, is among the recent arrivals at San Francisco.

Herbert Fleishhacker, one of the directors of the Great Western Power Company, returned to San Francisco during the week from New York City, where he spent some time in connection with financial affairs.

A. W. Bullard, vice-president of the Great Western Power Company made a 400-mile inspection tour of the company's system of power stations, dams and transmission lines before leaving for New York last Monday.

H. W. Clapp and **B. C. Edgar** have resigned their positions with the electrical department of the Southern Pacific Company at San Francisco to join the engineering staff of the Columbus (Ohio) Railway & Light Company.

A. S. Hayward, formerly transformer specialist for the General Electric Company's Pacific Coast District, recently returned to San Francisco after visiting the factory at Schenectady, and will sail on Saturday for Honolulu, where he will open a General Electric agency for the Hawaiian Islands.

Arthur A. Isbell, construction engineer for the Marconi Wireless Telegraph Company, returned to San Francisco last week after superintending some changes in the company's station at Honolulu, preparatory to the proposed operation of the wireless system between the Hawaiian Islands and Seattle.

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, plans to leave for the East on November 3. In addition to attending the directors' meeting of the National Electric Light Association he will give a number of addresses on California hydroelectric plants and also urge attendance at the Panama-Pacific Exposition in 1915.

K. G. Dunn, with Hunt, Mirk & Company, has returned to San Francisco after inspecting the work in progress at San Diego, where a large percentage of the underground steam mains for the United Light, Fuel & Power Company, has been installed. The American District Steam Company's system of low pressure steam heating is used. The Spreckels Theater and other large buildings are now being supplied with steam.

S. L. Naphtaly, vice-president of the Oakland, Antioch & Eastern Railway, has returned from the East after conferring with officials of the War Department concerning the bridge the company intends to construct across Suisun bay. All arrangements have been completed and machinery for making the final borings, to determine where the concrete structures will be placed, has been farwarded from the north by the engineers in charge of the bridge construction.

W. H. Leffingwell is in charge of a crew of men who are doing some hydraulic work on the Nevada Valleys Power Company's proposed hydroelectric development on the Truckee River, a short distance east of Sparks, Nevada. According to plans that have been announced, a drop of 90 feet will be obtained by constructing a 4½-mile ditch and a dam 18 feet in height. The latter is to be constructed on the same principle as the Derby dam on the Government irrigation project near Clarks. An installation of two generating units, aggregating 3500 h.p., is contemplated.

S. V. Walton, commercial manager for the Pacific Gas & Electric Company, has returned to San Francisco from an extended trip throughout the East. Mr. Walton has been appointed chairman of the N. E. L. A. Pacific Coast committee on electricity on the farm. The other members are **S. M. Kennedy,** general agent of the Southern California Edison Company; **E. B. Walthall,** assistant general manager of the San Joaquin Light & Power Company; **H. S. Wells,** manager of the new business department of the Pacific Power & Light Company; **C. H. Williams** of the Northern Colorado Power Company; **E. P. Edwards,** assistant manager of the lighting department of the General Electric Company of Schenectady; **H. W. Cope,** manager of the industrial and power department of the Westinghouse Electric & Manufacturing Company. The two latter will represent the large manufacturing companies. The project was brought up at the meeting in Boston recently of the executive committee of the commercial section of the National Electric Light Association, and after the meeting adjourned Mr. Walton and other men of national reputation as sellers of electrical energy, visited Washington and conferred with officials of the Department of Agriculture, who will aid the campaign in many ways. First a booklet will be produced giving the present and prospective users of electricity on the farm concrete facts, showing the value of the power for pumping, lighting, heating, etc. This will be brought out under the auspices of the National Electric Light Association. It is proposed to bring the campaign into the home of every agriculturist.

TRADE NOTES.

J. J. Agutter and associates have organized under the name of J. J. Agutter & Company for the purpose of carrying on a general electrical contracting and engineering business. The firm is located at 73 Madison street, Seattle.

The Westinghouse Electric & Manufacturing Company has delivered the first one of the fifteen electric locomotives ordered by the Pacific Electric Railway Company of Los Angeles. The 60-ton locomotive will be used principally to operate freight and passenger trains on the interurban lines running out of Los Angeles.

The Century Electric Company of St. Louis has inaugurated the practice of assembling its workmen to hear the arguments of noted speakers upon the political questions of the day. The first speaker was Charles W. Fairbanks, former Vice-President, who addressed the employees at noon on October 23rd.

The General Electric Company has sold the Union Iron Works of San Francisco, a quantity of electric equipment for the fine new substation at the Potrero shipbuilding plant. This includes two 6-pole, 3-phase, 200 kw., 1200 r.p.m., 60 cycle, 230-v. rotary converters; one 50 kw., 1200 r.p.m., motor generator set—440 v., 3-phase, a.c., and 125 v. d.c.; one 165 kw., 900 r.p.m., motor generator set—440 v., 3-phase, a.c., and 330 v. d.c.; one 150 h.p., 600 r.p.m. 3-phase, 440 v., induction motor, and an 18 panel black slate switchboard, to control the entire substation, which will furnish current for the operation of the machinery in the yards and shops.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

NEW ELECTRICAL WIRING ORDINANCE AT PORTLAND.

(Concluded.)

Certificate of Roughing in and Final Inspections.

Section 771. The Chief Inspector of Electricity shall be notified in writing by the person or persons doing work, first when roughing in work is completed, and again when the entire work is completed, in both cases within forty-eight (48) hours after the completion of said work. The Chief Inspector or his deputy shall proceed to inspect the same within forty-eight (48) hours, not including Sundays or holidays, after receipt of such notice, and if said work is in all respects in conformity with the provisions of this ordinance he shall attach a notice giving permission to proceed with the installation. Should the inspector condemn any of the said work or equipment as not being in accordance with the provisions of this ordinance, such rejected wires or equipment shall at once be removed and changes demanded by the inspector or his deputy shall be made by the electrical contractor within a reasonable time after written notice is received by him so as to bring the same up to the requirements of this ordinance. In default, said electrical contractor shall be liable to the penalties of this ordinance, and any and every lather, carpenter, mason, electrical contractor, owner, agent or any other person covering or allowing to be covered such portion of work or equipment so condemned, or removing any notice not to cover same placed thereon by the Chief Inspector of Electricity, or his deputy, shall likewise be liable to the penalties of this ordinance. Failure of the Chief Inspector of Electricity, or his deputy, to make inspection as prescribed above within forty-eight (48) hours will be construed to mean permission to the lather, carpenter, mason, electrical contractor, owner, or agent to proceed with the construction of the buildings.

Certificate Not to Be Issued on Incomplete Work.

Section 772. No certificate will be issued on any incomplete work. When any addition or change is made in work upon which a certificate has been issued, a separate permit and certificate shall be obtained for same.

All Pipe Work to Be Installed Before Electrical Inspection.

Section 773. All roughing in plumbing and other pipe or tube work to be concealed shall be in place before electrical wiring is inspected, and no such wiring shall be considered as complete until such piping is in place.

Certificate of Final Inspection to Be Issued Before Connection Made to Source of Power.

Section 774. It shall be unlawful for any electric light or power company to do any wiring of any nature in or on any building, except their own power house or substation, for which a permit has not been issued, or to make any electrical connections to any building until a certificate of inspection of said building has been issued by the Chief Inspector of Electricity; provided, however, that the Chief Inspector of Electricity may issue a temporary permit for the use of electric current during the construction or alteration. No charge is to be made for this temporary permit.

Inspection of Old Work.

Section 775. The Chief Inspector of Electricity, or his deputy, shall have the right to enter into all buildings where electric current carrying wire exists for the purpose of inspecting the same.

Maintenance.

Section 776. The said Chief Inspector of Electricity or his deputy is hereby empowered to inspect or reinspect all wiring in or on buildings and apparatus conducting electric current for light, heat and power, and when said conductors or apparatus are found to be unsafe to life or property he shall notify the person or corporation using or operating them to place the same in a safe and secure condition within forty-eight (48) hours. Any person or corporation failing or refusing to repair, change or remove same within forty-eight (48) hours, or within such further time as the Chief Inspector of Electricity deems necessary, after receipt of such notice, shall be subject to the penalty hereinafter provided.

TITLE II.

All Work to Conform to Electric Code.

Section 777. All electrical wiring and appliances in or on buildings inside of the city limits of the City of Portland hereafter erected, altered or repaired, shall conform to the National Electric Code, Edition 1911.

Section 778. The following local rules shall apply to electrical installation for light, heat and power in or on buildings in the City of Portland and to be an addition to the electrical code as set forth in Section 777.

Conduit Work.

(a) All electrical installations in buildings which are hereafter erected, altered or repaired in the inner fire limits shall have wiring encased in approved metal conduit, provided extensions to existing installations, not installed in conduit may be made in a manner similar to the existing installations, provided the extension does not require any new circuit or circuits.

(b) All electrical installations in basements of buildings which are to be hereafter erected, altered or repaired, in the outer fire limits, unless concealed, shall have the wiring incased in approved rigid or flexible conduit. Installations made in wood or metal moulding not to be construed to be "concealed work." This shall not apply to buildings which are occupied by four families or less.

(c) All buildings hereafter erected, altered or repaired to be used as public garages shall have their electrical wiring encased in either rigid or flexible conduit.

(d) The ends of all wires at outlets, where fixtures are not installed, must be tapped and provided with approved outer covers.

(e) All wiring for signs must be in conduit. For swinging signs conduit to extend to sign axis and terminate in an approved water-tight fitting; from this fitting wires to be neatly cabled, and where the wires enter the sign structure they are to be properly bushed. If sign is of stationary construction, conduit must enter structure in approved manner.

(f) Conduit work on outside of building must be water-tight; socket and receptacles must be weather-proof.

(g) Wiring on outside of building must be encased in conduit.

(h) Conduit must be installed so that it will not be necessary to leave fish wire in same in order to pull in conductors.

(i) All outlet and junction boxes, condulets, unilets, pipe ends and fittings of similar make must always be accessible and must not, under any circumstances, be concealed, and must be secured with screws not smaller than No. 8.

(j) On conduit jobs all necessary cutouts, cutout cabinets, switches and other material and devices must be installed and all outlets properly connected before any certificates of final inspection will be issued.

(k) All conduits must be double lock-nutted to cabinets, outlet boxes, junction, pull and switch boxes.

Knob and Tube.

Section 779. (a) At the three-way and gang switches, taps must be made and secured outside of boxes.

(b) Wires must not run diagonally through joists, studding or timbers.

(c) Wires must be knobbed at top and bottom of partition; that is, just above mud tubes and below the plates.

(d) Broken tubes or knobs must not be used for mud tubes.

(e) All tap wires must be knobbed within six (6) inches of tap.

(f) In attics which are reached only by scuttle hole wires must be kept at least five (5) feet from scuttle, or be considered as subject to mechanical injury.

(g) Do not knob on one-inch header block at outlets.

(h) Avoid running wires under bathrooms or near sinks wherever possible.

(i) Joists to be properly made must be heated sufficiently to allow the solder to flood same, then covered with two (2) thicknesses of rubber tape and at least two (2) thicknesses of friction tape.

(j) Where metal lath or metal ceiling is used outlets must have approved outlet boxes. Open work, knob and tube or cleat work on grounded surfaces, such as metal lath or metal ceiling, is prohibited.

Service.

Section 780. (a) All buildings having their electric service either from overhead or underground service must be fed separately; that is, one building must not be fed through another unless the connection is made by conduit and the conductor carried on outside of building or buried in six (6) inches of concrete or brick. This permission is given only by a written order from the Chief Inspector of Electricity.

(b) In buildings containing more than one (1) tenant all services must be brought to one distribution center.

(c) No wire smaller than No. 12 B. S. gauge may be used for service.

(d) Service wires for all buildings must be installed in conduit from a point ten (10) inches beyond outside wall to and entering iron cabinet for main service cutout.

(e) All knife switches and cutouts must be installed in approved cabinets.

(f) No fuses, switches or meters must be mounted on back of switchboard. Where such a design is intended, the above apparatus should be mounted on sub-panel at the rear of the switchboard.

Size of Mains.

Section 781. For the purpose of determining the size of wire for mains, each circuit will be considered as carrying full load except theatres, where maximum possible load is considered.

Wooden Moulding.

Section 782. Wooden moulding for electrical wiriug is prohibited inside the fire limits, except as set forth in Section 778, (a) and (b). Soft wood moulding for electrical wiring is prohibited within the city limits of Portland.

High Voltage.

Section 783. Wires carrying current in excess of 600 volts are prohibited in buildings except for motors and transformers.

Motor installations above this voltage must conform to the following specifications:

(a) On pole outside of building locate three transformer fuses as starting fuses, isolated from all combustible or inflammable materials.

(b) All wiring must be done with approved multiple conductor metal sheath cable in approved unlined conduit.

(c) All wiring around switchboard must be done with approved rubber insulated wire. This wire must be of approved make for this potential—ordinary 0 to 600 volt wire is not approved.

(d) All open wiring must be supported on porcelain insulators at least 1 inch high, and wires must be 8 inches apart.

(e) Use bushings on the ends of all conduit as a terminal fitting. Do not use outlet boxes or condulets.

(f) No iron cabinets can be used. Use wood—slate or marble lined—that is, build the cabinet of wood.

(g) Wherever lead-covered cable leaves conduit, place a pot head on the lead-covered cable and fill it with asphaltum so as to separate wires. This pot head should be at least twice the diameter of the metal sheathed cable.

(h) Enclose the motor in a dust-proof room when direct current motors are used.

(i) Place the starting panel in the motor room; also the auto starter and the oil switch. If no room is provided one must be built for this apparatus.

(j) Ground thoroughly the motor frame, the conduit and the metal sheathed cable. This grounding to be done with approved clamp.

(k) On the outside of the building the conduit must be turned downward with a bushing on the same and a pot head must be used on the lead-covered cable.

(l) Connect the starting terminals of the compensator between the oil switch or fuses on outside pole and circuit breaker on the starting panel, making the circuit breaker on the panel the "Running Fuses."

(m) If it is necessary to dead end to the building, place several strain insulators in series.

(n) Motor must be so located that it will be readily seen from the auto-starter.

Number of Outlets Per Circuit.

Section 784. The maximum number of outlets per circuit, provided not more than 660 watts are consumed, shall be as follows:

	Outlets.
For stores and offices if more than three (3) ft. apart....	6
In buildings not mentioned above—For concealed work..	12
For open work	12
For signs and outlining the outside of buildings........	66

is the maximum number, except signs wired in series-multiple; for lamps of five (5) watts or less a maximum of 200 sockets shall be allowed.

Low Voltage Transformer.

Section 785. In low voltage transformer, when the highest voltage of either primary or secondary does not exceed 550 volts and the apparatus that constitutes the load is capable of carrying over one (1) ampere, both the primary and secondary wiring must be installed according to Class "C" rules of the electric code.

When the secondary current does exceed one (1) ampere at twenty-four (24) volts, and is used for signalling work, the secondary wiring may be installed according to Class "E" rules of the electric code.

Extra Hazard.

Section 786. In all installations in stables, barns, breweries, wood-working plants, laundries, packing houses, dye works or factories and where flying dust accumulates, sockets must be waterproof. Unless made upon fixtures, they must be hung by separate stranded rubber-covered wires not smaller than No. 14 B. S. gauge, which should be twisted together when the pendant is over three (3) feet long. These wires must be soldered direct to the circuit wires, but supported independently of them.

Starting Devices.

Section 787. All alternating current motors whose normal capacity is six (6) horsepower or more must be provided with approved compensator or equivalent device to reduce the excessive starting current required; and direct current motors of one (1) horsepower capacity and larger must have starting boxes.

Exit Lights.

Section 788. The exit lights required by Section 713 must be on separate circuit, or circuits connecting on the service

side of the main line fuses, with only one (1) set of fuses between the light and the service main line.

Non-liability of City for Damages.

Section 789. This ordinance shall not be construed to relieve from or lessen the responsibility of any person owning, operating or installing any electrical wires, appliances, apparatus, construction or equipment for damages to anyone injured by any defect therein; nor shall the city, or any agent thereof, be held as assuming any such liability by reason of the inspection authorized herein or the certificate of inspection issued by the Department of Buildings.

Penalty for Violation.

Section 790. Any person, firm, company or corporation that violates, disobeys, omits, neglects or refuses to comply with, or resists, or opposes the execution of, or violates any of the provisions of, or who occupies or maintains any building or structure which was erected or altered in violation of this code, shall be punished by a fine of not exceeding five hundred dollars ($500), or by imprisonment of not more than six (6) months, or by both such fine and imprisonment, and every person, firm, company or corporation shall be deemed guilty of a separate offense for every day such violation, disobedience, neglect or refusal shall continue, and shall be subject to the penalty of this section for each and every separate offense, and so much of any building or structure as may be erected or altered in violation of this Code shall be condemned and torn down at the expense of the person, firm, company, or corporation erecting or altering the same.

CALIFORNIA ELECTRICAL CONTRACTORS' NOTES.

J. G. Sutton Company are installing an 80 h.p in. motors for John Roebling's Sons at Oakland.

The Central Electric Company were awarded an apartment house on Geary and Jones streets, San Francisco, for the sum of $2600.

A great deal of electric work is being done in San Francisco and the surrounding towns at the present. Reports from union headquarters shows that there are no idle men.

C. V. Shneider, manager of the electric Supply Company in Sacramento, was in the city on business during the week.

The wiring for the Kahn Department Store was awarded to the Electric Construction Company of Oakland on a percentage basis. A number of San Francisco firms were called in to submit estimates on this job, and their figures ran close to $20,000. Whether it was the intentions of the owners of this building to let this job on a percentage basis or not, the fact remains that a number of contractors have been put to considerable expense preparing estimates that according to the looks of things the owners did not intend to use.

A committee consisting of C. F. Butte, C. Eppestien, Russ Woldron and W. S. Hanbridge has just completed a revision of the Buyers' Reference Price List of Electrical Supplies for San Francisco District, Local No. 1, California State Association of Electrical Contractors. The new book is much larger than the old one, is gotten up in loose leaf form so as to fit any standard binding, and the committee hopes that it will be the forerunner to a western sheet for the National Data and Sales Book. The priecs in the book are what the committee consider reasonable and proper and books are to be sent to all contractors and dealers, but with an understanding that there is no reason that these prices should be used except where in the judgment of the user that they are fair to himself and the consumer. The distribution will take place about December 1, 1912.

The Contractors' and Dealers' Association have appointed the following committee to look after segregation of contracts on the World's Fair buildings: W. S. Hanbridge, representing Electrical Contractors; G. Guthrie of J. G. Sutton Company, representing Plumbers; W. T. Beck, representmening Painters; W. A. Knowles, representing Plasterers; W. A. Burnham, representing Steam Heating men. It is the hope of the Contractors' and Dealers' Association that the Fair Commission will take the same liberal stand on this matter that Mayor Rolph and the City Architectural Commission took, and segregate the work on each building into several contracts, therefore not making it necessary for the contractors, who really do the work and must necessarily finance this work, "with the assistance of their supply men," to bury their identity, have their bids peddled, and assume the risk of not getting their money which will be the case many times if the Commissioners insist on giving the work to a general contractor.

OREGON RULING ON "OLD CODE" WIRE.

The Underwriters' Equitable Rating Bureau of Portland has notified electrical contractors, wire manufacturers, jobbers and the electrical trade in general, who might purchase "Old Code" rubber-covered wire, that only stocks in Oregon on the 1st of August, 1912, are acceptable. No wire of the "Old Code" type shipped direct from a factory or other stocks outside the State is acceptable. All "Oregon Stocks" are invoiced in this office and all purchasers of "Old Code" wire should find out whether or not the wire they contemplate purchasing is from an "Oregon Stock." Therefore, whenever wire of the "Old Code" type is found being used which does not come from "Oregon Stock," it will not be passed and if not removed after a reasonable time the fire insurance rate will be readjusted.

SAN FRANCISCO JOVIANS.

At the luncheon of the San Francisco Jovians on October 28th, J. A. Vandegrift gave an interesting talk on the process of manufacturing tungsten lamps. On November 5 A. V. Thompson will talk about the annual Jovian convention at Pittsburgh and provide other entertainment. The meetings are held at Tait's Cafe at 12:15 on Tuesday.

SPOKANE JOVIANS.

The Jovian luncheon on October 22d at Davenport's, Spokane, was addressed by T. H. Koerner, general agent of the Alaska-Pacific Steamship Company, on "Benefits this Territory Will Receive from the Panama Canal." E. Ashton, of the Inland Portland Cement Company, gave an address, illustrated by lantern slides, on "The Manufacture of Portland Cement." On October 24 the Jovians in a body visited the Little Falls and Long Lake development of The Washington Water Power Company, and the Nine-Mile plant of the Inland Empire Railroad Company. The party left in automobiles early in the morning and returned at night, being entertained for a camp dinner as guests of The Washington Water Power Company at their Long Lake plant.

TRADE NOTE.

The Electric Boat Company, of Groton, Connecticut, has decided to establish headquarters at Port Townsend for the finishing and testing of submarine boats. The company makes a specialty of this class of work and has come to the conclusion Port Townsend is a good location for it. Machinery has been ordered and contract entered into with the Key City Light & Power Company for a considerable amount of current to be delivered at the company's plant when in operation.

NEW CATALOGUES.

The Standard Underground Cable Company have issued a neat unique illustrated description of their extensive line of cable terminals and junction boxes in the form of a representation of a trunk.

INDUSTRIAL

LARGEST DIRECT CURRENT GENERATORS.

Seven vertical water wheel type electric generators, which represent units of the largest capacity ever built for generating direct current, will be installed in the new plant of the Southern Aluminum Company at Whitney, N. C. Each machine will have a rating of 5000 kw., delivering 20,000 amperes at 250 volts and operating at a speed of 170 r.p.m. Two smaller direct current generators of the same type, rated 2500 kw. at 300 r.p.m.; two 1250 k.v.a. alternators, having a speed of 514 r.p.m., with two 16 kw. exciters, and all necessary switchboards and controlling devices are also included in the installation.

The contract for all the electrical apparatus has been placed with the General Electric Company, and the installation will be one of the largest and most modern of its kind in the world. It is the intention of the Southern Alufniuum Company to push to completion the project now under way and to have in operation in the course of the next eight months a manufacturing plant that will turn out some 25,000 tons of aluminum annually.

The company was recently incorporated under the laws of the State of New York with a capitalization of $8,000,000 and was organized by some of the largest aluminum manufacturing companies of Europe. The enterprise has been financed in France and is closely associated with L'Aluminum Francais of Paris. The work at Whitney is in charge of Dr. Paul Heroult, an eminent French engineer, who is recognized as one of the most expert authorities in the world on the manufacture of aluminum. Although Dr. Heroult has been directing constructive operations there but a few weeks, remarkable progress has been made, and it is confidently expected that the entire plant will be in readiness for turning out the product of the company by the middle of 1914.

The plant throughout will rank among the greatest and most perfectly equipped for the manufacture of aluminum in the United States. Only one other in the country, at Niagara Falls, can compare with it. In the complement of buildings are nine furnace rooms, wherein the alumina will undergo the various processes incidental to conversion into aluminum. Each of these structures measures 60 by 500 ft., and one electrode factory of similar dimensions is also included in the group.

Aluminum, because of its lightness and toughness, finds an almost universal application nowadays. Wire and cable made of this product are rapidly coming into extensive use for the transmission of high tension electric power. A certain type of clay termed bauxite, which is found in Georgia and the middle West, enters into the manufacture of the commodity. From bauxite alumina is made, and through delicate and intricate electrolytic methods this is then transformed into aluminum.

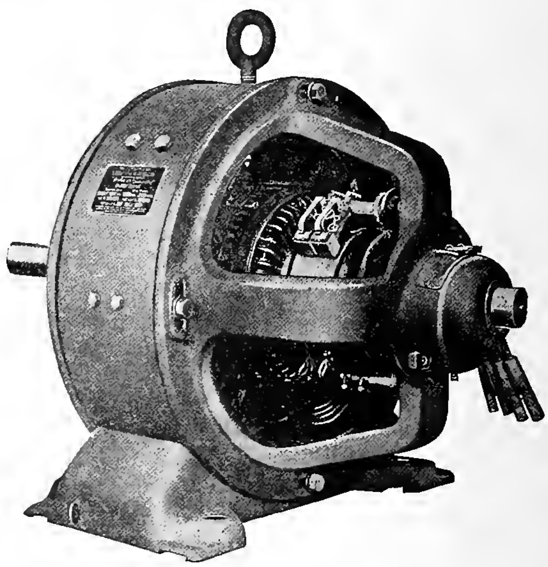
The immense machines, which will supply the electric current for the several operations of this vast industry, will be installed immediately over wheel pits and direct connected to vertical shafts of S. Morgan Smith turbines by forged steel flanged couplings. Each 5000 kw. generator will weigh in the neighborhood of 150 tons, measure 22 ft. in diameter and extend 13 ft. above the floor level. The entire rotating element of the generators will be supported from an overhead thrust bearing. While the normal speed will be 170 r.p.m., they will be designed with provision for a safety runaway speed of 75 per cent above normal. Simplicity will characterize the switchboards and controlling devices, and they will consist of types entailing an effective minimum number of parts. The wheel governors will be provided with remote electric control for both hand and automatic operation.

A NEW ELEVATOR MOTOR.

A new line of direct current, commutating-pole elevator motors has recently been put on the market by the Westinghouse Electric & Manufacturing Company. The principal reason for the development of this new line was the demand for a quiet operating direct current motor requiring a minimum of attention. In order to obtain the latter characteristics, type SK elevator motors have commutating poles, extra large and cool running bearings, and a very rugged and substantial construction throughout.

Excellent commutation is obtained principally by the use of commutating poles. This feature results in sparkless commutation even under severe overloads; frequent starting and stopping, and rapid acceleration incident to elevator service. Good commutation results in long life of commutator, brushholders and brushes; while freedom from deposits of coppei and carbon dust keeps the insulation of the windings and the commutator in good condition.

The motors develop very high torque at starting, and the controller is arranged to cut out the starting resistance auto-



A New Elevator Motor.

matically at a rate which keeps the torque practically constant while accelerating. The elevator car is, therefore, quickly started and rapidly accelerated to full speed.

Another advantageous point claimed for these motors is their quiet operation, a feature obtained by the peculiar design and distribution of its windings, and certain mechanical adjustments.

Quiet operation makes these motors very desirable for elevator installations in hotels, apartment houses, hospitals and office buildings, where a noisy operating motor would be objectionable.

The frame yoke is a slab of open-hearth steel, hot-rolled into its circular shape. It is riveted under pressure to a one-piece pressed steel foot, the bottom of which is machined to dimensions for mounting. The armature has a laminated core with ventilating slots. The shaft is removable without disturbing the armature windings or commutator connections. The commutator end of the shaft has an extension of 1¼ in. clear of the housing. This feature makes it possible to turn the armature on its shaft by means of a wrench.

For different kinds of elevator service, these motors are made in three classes. Class I comprises adjustable speed motors, suitable for high-speed passenger elevator service; Class II, for moderate-speed freight and passenger elevator service; Class III motors for slow-speed freight elevators.

NEWS NOTES

INCORPORATIONS.

SALEM, ORE.—Designating its capital at $2,500,000, and its incorporators as Max Smith, Marion F. Dolph, and Willis McGuire, the Ewbank Electric Transmission Company of Portland, has filed articles of incorporation. The purpose of the company is to obtain patents for a system of gas and electric transmission of power, and it is authorized to build and operate street car systems and to manufacture all kinds of motor vehicles.

SALEM, ORE.—Articles of incorporation for the Bandon & Oregon Eastern Railroad Company have been filed here, the incorporators being Roscoe C. Nelson, H. D. Simon and J. V. Beach. Capital stock is $100,000 and Bandon named as the principal place of business. The company is organized to construct a railroad from Bandon in Coos county, through the counties of Coos, Curry and Josephine to Eagle Point in Jackson County and also branch lines from Bandon to Marshfield and from Bandon to Port Orford.

ILLUMINATION.

MOCCASIN, MONT.—The Great Falls Power Company will erect a station here.

ABERDEEN, WASH.—K street, this city, is to be lighted with cluster lights. The property owners will furnish the posts and the cost for 16 clusters is estimated at $35 per month.

HEMET, CAL.—The Southern Sierras Power Company is preparing to extend its lighting service to Park Hill residents, as soon as a sufficient number have signed for lights to justify action.

LYMAN, WASH.—An ordinance has been passed by the city council granting permission to the Pacific Northwest Traction Company to erect, maintain and operate an electric lighting system in this city.

GALLUP, N. M.—Application has been made to the city council for granting of a franchise for the erection of a new electric lighting and power plant for the city. T. A. Fabro and J. M. Mase are promoting the business, Mr. Mase acting as manager.

POTLATCH, WASH.—The West Coast Power Company, J. E. Wickstrum, engineer, Seattle, is planning on installing a 300 h.p. hydroelectric plant on the Skykomish River near here. The plant will be built for commercial purposes and, it is claimed, contracts for half the power developed have been made.

SEATTLE, WASH.—The city utilities commission has recommended for passage an ordinance providing for submitting the question of a bond issue of $425,000 to the voters at the general election next March, the fund to be used for installing a steam auxiliary plant at the south end of Lake Union to aid the lighting department.

FRESNO, CAL.—The city government has received notification that the Pacific Gas & Electric will bring suit to prevent the enforcement of the dollar-gas ordinance which was passed last spring on an understanding that the company would not resist it this fall. The ordinance took effect October 1, reducing the rate from $1.35 to $1.

LOS ANGELES, CAL.—A temporary check to advertising $25,000 bonds voted by the citizens of Newport Beach for the municipal electric lighting plant, has been given by the opposition of the Newport Electric Light & Power Company, which has raised the question whether provisions governing public utilities apply to the municipality conducting such business under the law.

SAN DIEGO, CAL.—Notice is hereby given to all stockholders of the San Diego Consolidated Gas & Electric Company that a meeting will be held December 23 for the purpose of considering and acting on the proposition of increasing the bonded indebtedness of the company not exceeding $3,000,000; said bonds to be issued for the purpose of discharging floating indebtedness of the corporation. Bonds payable not later than December, 1922, bearing interest at a rate not to exceed 6 per cent per annum.

FRESNO, CAL.—To supply Fresno with natural gas from the Coalinga oil fields it would cost the city anywhere from $250,000 to $425,000, according to estimates made by City Engineer Jensen and Civil Engineer Tillman. These estimates are based on the laying of an 8-inch pipe line over a distance of 68 miles. Jensen figures the maximum cost at $425,000 and the minimum at $250,000. Tillman places it at $390,000 for 8-inch pipe or at the rate of $1 per lineal foot. For 6-inch pipe the cost would be less than a quarter of a million, but it is believed this size would be too small to supply the demand in the pipe line now in operation between the Sunset fields of Kern County and Los Angeles 8-inch pipe is used. Another line of 8-inch tubing is now being laid and the supply is said to be unlimited.

TRANSMISSION.

ESCONDIDO, CAL.—The Escondido Light & Power Company, a new electric and power company organized some time ago, to furnish light and power to country districts, is arranging to start work on a system to cost about $40,000. The stock of said company is offered for subscription.

CONCRETE, WASH.—The city council has been asked to grant the Stone & Webster interests a fifty year franchise for the use of a sufficient number of streets and alleys to enable the company to build, maintain, and operate a continuous system of high extension wires from the east to the west limits of the city.

THE DALLES, ORE.—The Pacific Power & Light Company has started work on a new transmission line to cross the Columbia River and supply power to the Grandalles Orchard Tracts Company's pumps. The line calls for 342 poles and steel towers. The longest span will be 2700 ft., 150 ft. towers being employed. Two new transformers will be installed at The Dalles substation.

DOWNIEVILLE, CAL.—The Marysville & Nevada Power Company, promoted by Jas. O'Brien of Marysville, is advertising for bids for running a tunnel to divert the waters of the river at Goodyear Bar for the purpose of generating electricity. The water is to be taken through a point and dropped to the power house. A dam will be built next year to raise the water to the level of the tunnel. Jason K. Meen and John E. Ebert, both of Marysville, are associated with O'Brien in the enterprises, as is also James K. O'Brien.

TRANSPORTATION.

HOOD RIVER, ORE.—It is reported that the Harriman interests will construct an electric line in the Hood River valley.

POCATELLO, IDAHO.—A syndicate headed by James H. Brady, local capitalist and others, has asked the city for a street railway franchise.

CENTRALIA, WASH.—The Olympia Terminal Railway Company has been organized to operate an electric line between Olympia and Chehalis.

PORTLAND, ORE.—The Portland Railway, Light & Power Company will start at once the construction of a double street railway track 1¾ miles into the peninsula.

MONROE, WASH.—The Kirkland-Redmond Railway, Light & Power Company has asked for a franchise to lay rails on Ferry and Fremont streets and agrees to have cars running by October 10, 1914.

RIALTO, CAL.—The Board of Trustees has adopted an ordinance granting a franchise to the Crescent City Railway Company to construct a single or double track street and interurban railroad for a period of fifty years.

LONG BEACH, CAL.—An appropriation of $170,000 has been made by the Pacific Electric for improvement of tracks at Long Beach. The intentions are to replace the light weight rails in the business center with heavy steel, heavily ballasted, laid on 12 inches of crushed stone, surface paved.

SAN BERNARDINO, CAL.—The people of Redlands and Highlands are coming to the aid of San Bernardino in raising the $35,000 fund to purchase the right of way for the Pacific Electric Railway Company into this city. About $10,000 remains to be raised of a total of $42,000, representing the cost of both shop site and right of way.

PETALUMA, CAL.—Contractors have begun grading in Liberty station for the new electric railroad which is to be built from that point to Two Rock Valley and later to Bloomfield. The Petaluma & Santa Rosa Valley Railway Company intends to go ahead with the work of building the road, which it contemplates having finished before the first of next year.

LOS ANGELES, CAL.—Declaring that the California Main Line Railroad, which was incorporated February 14, 1912, under the name of the California Air Line Railroad Company, with a capitalization of $20,000,000, is ready and willing to finance the construction of the municipal railway to the harbor for the city, Attorney Glen Behymer of the firm of Behymer & Craig, has filed an offer with the city council to construct and operate the road.

RIVERSIDE, CAL.—The Chamber of Commerce is considering the proposals of the American Traction Company to locate in this city. The traction company wants a formation of local capitalists for a company, to whom it will give the right to manufacture machines upon which it holds a patent, retaining exclusive sale of same at designated profit to manufacturers. Henry F. Boynton, L. P. Nemcomb and J. P. Barker, representing the company, are in the city.

SAN FRANCISCO, CAL.—Delays in the construction of the cars for the Geary street road by W. L. Holman & Company have become so serious that Mayor Rolph has been asked by the Board of Works to summon the contractors and their bondsmen for an investigation. City Engineer O'Shaughnessy reported to the Works Board that it would take the contractors several months longer to complete the cars than the contract specified, and that the last 11 cars probably would not be finished until after September 11, 1913.

EXETER, CAL.—The presence here last week of Paul Shoup and C. H. Jasper, traveling freight agent of the Southern Pacific who, together with W. P. Ballard, local superintendent of the Visalia Electric, went over the line and then to Lindsay and Porterville was for the purpose of ascertaining the feasibility and cost of electrifying the Southern Pacific line from Goshen to Visalia and from Exeter to Porterville and to run electric cars between these points, both ways from Exeter. After going over the projected lines they went away leaving it for the superintendent here to make an estimate of the expense necessary. This was later done and the matter has gone up to the head office for consideration.

LOS ANGELES, CAL.—With the adoption of a compromise plan for the relief of traffic congestion on Main street, the councilmen are now united in an effort to expedite the plans and to proceed with the actual construction of the street railway line on San Pedro street. The Board of Public works has instructed the city engineer to prepare the plans and specifications and the estimated cost of the link of the municipal railway from Ninth to Aliso streets. The compromise plan as adopted by the Council provides for the following: The construction of the link of the municipal railway on San Pedro street between Ninth and Aliso by the city; the road to be actually built by the Pacific Electric for the city, on payment of a small installment, and the balance on easy terms; the granting of an indeterminate operating franchise to the Pacific Electric revocable by the city with one year's notice, the maximum tenure being seven years; the right to be given to the Pacific Electric to use Los Angeles street, between First and Seventh streets, if the city terminates the right to use San Pedro street during the seven-year term; the Pacific Electric to use Los Angeles street, for a period of ten years from the date of the grant, to be terminable at the expiration of the 10-year period with one year's previous notice; the city to reserve the right to construct the line on Los Angeles street for use by the Pacific Electric, this option to be declared by the city when the San Pedro street franchise is terminated; the maximum term in any case to be 21 years, in accordance with the provision of the charter.

TELEPHONE AND TELEGRAPH.

SOUTH PASADENA, CAL.—The Merged Sunset and Home Telephone Companies of Pasadena, have purchased a site on Mission street and will erect a substation on the property.

REDLANDS, CAL.—The city trustees will order the removal of all electric light, telephone, telegraph and traction line poles on the main streets in the business section of the city. The companies will be forced to place their wires underground.

TROPICO, CAL.—The Pacific Telephone & Telegraph Company has been granted the right to construct and for a period of 21 years maintain and operate a telephone and telegraph system for all purposes, commercial or otherwise, in all highways and public places in the city of Tropico.

BERKELEY, CAL.—Acting for the city council, City Attorney R. C. Staats, has filed a suit in the Superior Court in Oakland to prevent the merger of the Pacific Telephone Company with that of the Home Company. The action is to be taken at this time to intercept the Pacific Company in its work of dismantling the Home Company plant. If the City Attorney is not successful in this action, further proceedings will be instituted to attempt to secure for the city the forfeiture of the $25,000 bonds deposited with the city when the Home Company secured its franchise.

NEVADA CITY, CAL.—The telephone line between Miller's ranch and Camptonville which was constructed by the Tahoe National Forest service within the forest, has been completed and the line between Schaefer's Mill camp and the Truckee Rangers' station is also ready for service. This line will connect the forest service's Lake Tahoe system with the Truckee range station near Truckee. The Tahoe forest is now crossed with a network of telephone lines, which during the past two fire seasons has aided materially in the prevention of large forest fires.

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VOLUME XXIX | SAN FRANCISCO, NOVEMBER 9, 1912 | NUMBER 19

WOOD STAVE PIPE DISTRIBUTION

BY H. J. KENNEDY, M. E.

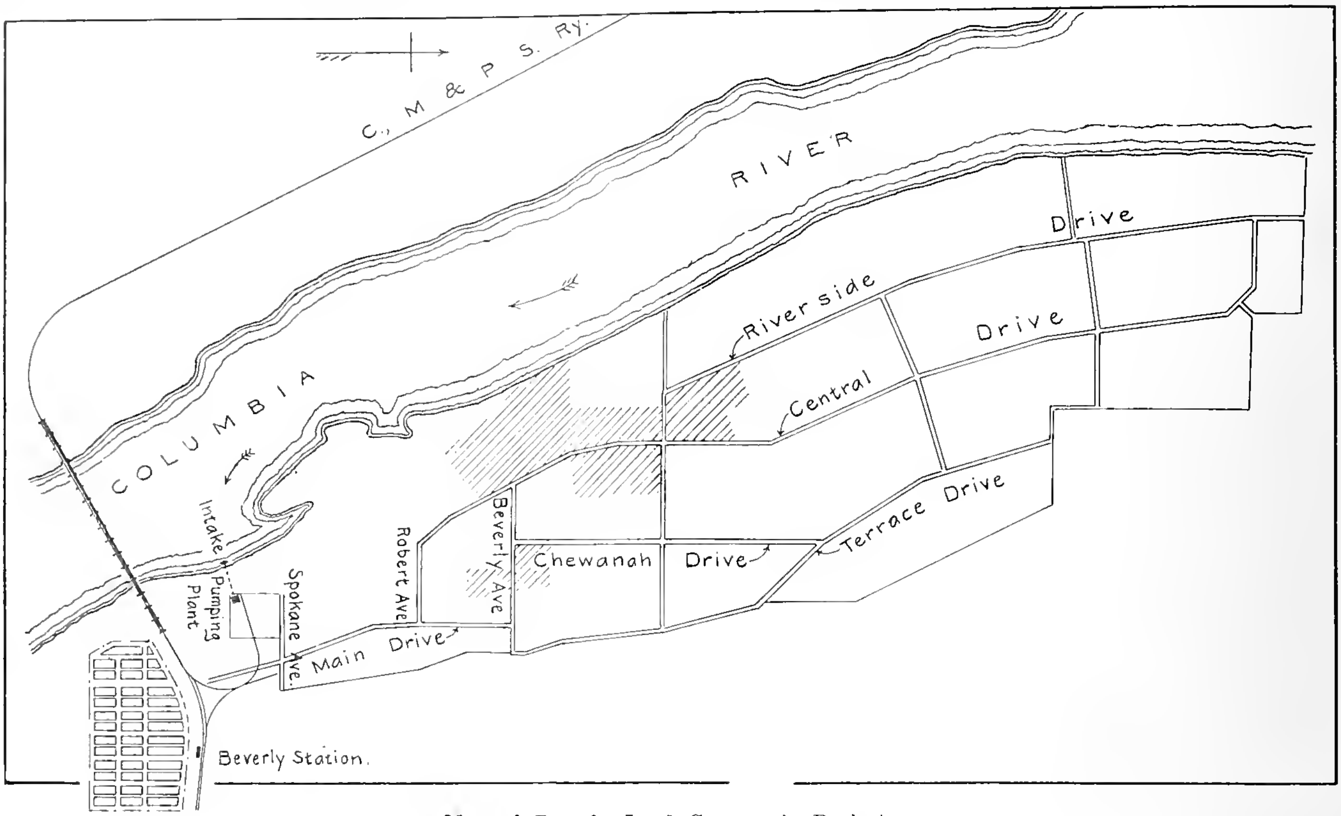
Travelers on east-bound trains of the Chicago, Milwaukee & Puget Sound Railway, after riding many miles surrounded by scenery devoid of trees, brown and gray with sand and sage-brush, note with relief, when descending the long grade leading down to the Columbia River bridge, the appearance of an incipient oasis in the desert. Large patches of green on the land sloping to the opposite bank of the river, indelibly indicate that after various setbacks and changes in the ownership of the project, the irrigation enterprise at Beverly, Wash., is now actually in successful operation.

The combination of a plant of the waterworks pumping engine type, with a pipe distribution system, is as yet unusual in northwestern irrigation, and particular interest therefore attaches to the accompanying illustrations and descriptions.

This plant has been completed by the Beverly Land Company. The pumping equipment is intended to irrigate a large tract of land lying for several miles on the left bank of the Columbia directly north of Beverly and reaching back nearly a mile from the edge of the river. The soil is volcanic ash, and sandy loam, several feet deep, with gravel sub-soil. There is a gradual slope down to the river, giving excellent grades for irrigation. The project was started with a view to developing an orchard region like those which have made famous other fertile valleys of the State, the fruits considered most favorable being peaches, apricots, nectarines, cherries, plums and strawberries. Late winter apples and pears may also be grown.

Making "Buckle" in Wood Stave Pipe.

The irrigation season lasts for six months, from April 1st to October 1st. The average annual precipitation is between seven and eight inches. Water is



Map of Beverly Land Company's Project.

taken directly from the river and pumped into the distribution system, which consists of wood-stave pipe, extending throughout the project. In order to compensate for variations between the amount of water being drawn off through the outlets and the amount delivered by the pump, as well as to provide a certain amount of storage when the pump is not working, a reservoir has been constructed at an elevated point, and a twelve-inch branch from the 26-inch main delivery line permits a flow to and from the reservoir.

The intake is a reinforced concrete structure located in the river, several rods from shore. The various levels of water in the Columbia are as follows:

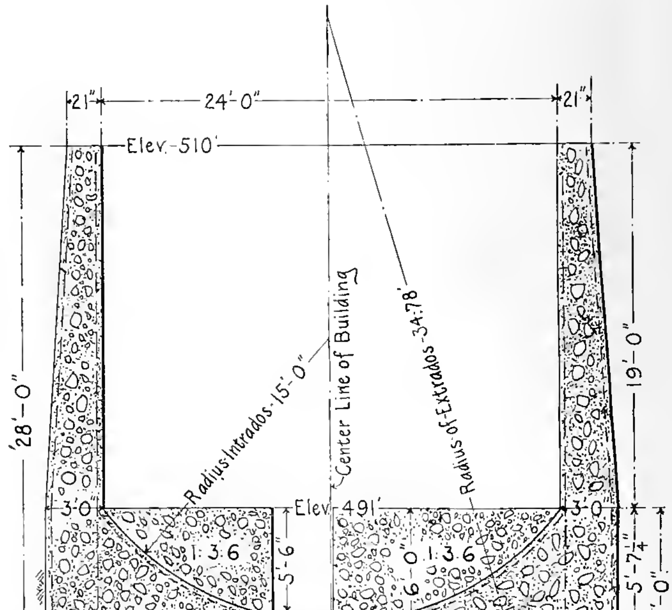
Extreme Low water, elevation above sea..............	473.4
Ordinary high water, elevation above sea..............	494.8
Extreme high water, elevation above sea..............	508.9

The bottom of the concrete footing supporting the intake, which rests in the gravel bottom of the river, is at an elevation of 467.4.

The intake pipe is 30 in. inside diameter, of concrete 3½ in. thick, reinforced by wire mesh, and laid in the gravel bottom of the river with its axis practically horizontal. It extends between the intake structure and the "sand catcher" or settling chamber which forms a part of the pumping plant building. This building is a reinforced concrete structure with wooden roof. It consists of boiler and engine rooms and suction wells or sumps. The boiler room is at the easterly end of plant, with floor at approximately ground level and a basement below, the latter being designed for future installation of a car for removing ashes, if found desirable.

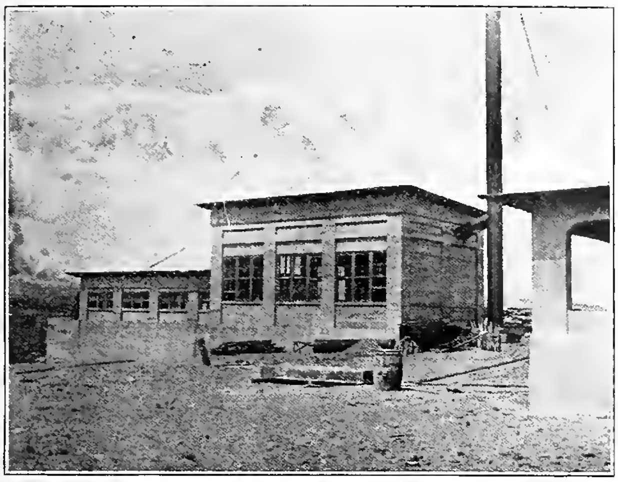
The engine or pump room is 24 x 48 ft. inside. The machinery is all below the ground level, in a pit completely lined with concrete, in other words it sets in a big reinforced concrete tank. The hydrostatic pressure of the ground water made necessary great strength against upward and lateral thrust for the bottom and sides of the pit. To resist this, an inverted arch of reinforced concrete was adopted for the bottom of pit, as shown in the illustration.

The initial steam generating installation consists of one Stirling water-tube boiler built by the Babcock & Wilcox Company at their Barberton works, contain-



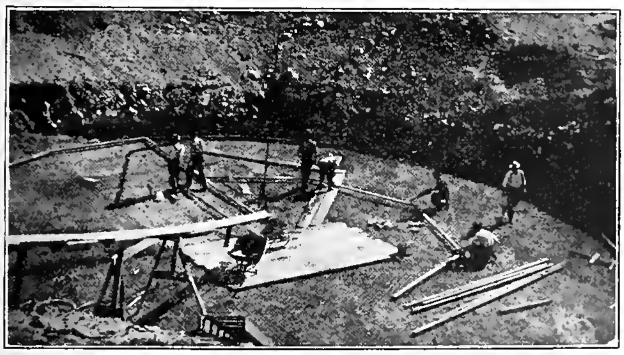
Transverse Vertical Section of Pump Pit.
PUMPING PLANT, BEVERLY LAND CO., WASH.

ing 170 tubes 3¼ inches diameter, three steam drums 36 inches in diameter, and one mud drum of same diameter. When the design of the plant was in its early stages, the question of using California oil for fuel was seriously considered. Owing to the railroad freight charges from tide-water, this point is in the zone where the economy of using crude pertoleum is problematical, since coal is produced in the state at a distance of a moderate haul. The plant has consequently



Pumping Plant of Beverly Land Company.

been installed without oil-burning appliances, since coal has been secured for less than three dollars a ton. It is a peculiarity of this region, that, whereas not a growing tree can be seen in the landscape, except where planted, yet there is a large amount of good timber and fire-wood to be had on the banks of the Columbia, as this wood is carried down stream from the giant forests through which the upper portions of this great river flow.



Reinforcement on Bottom of Reservoir.

The pumping engine is of the horizontal cross-compound condensing Corliss type. The operating conditions of the pump are that it should, when supplied with steam having a pressure of 150 lb. per sq. in. at the throttle, pump 6000 gallons per minute (13.3 cu. ft. per second) against a total head of 82 ft., or about 35½ lb. per sq. in. The reservoir was, however, placed in a somewhat different position from that originally contemplated, putting a greater head on the pump, so that the total operating head from mean water level to the reservoir is now 92 ft.

Delivery Line and Distribution System.

The use of a pipe distribution system, with the consequent reduction of seepage and evaporation losses, and freedom in location of the lines, is gradually gaining ground in the Northwest, especially where, as at Beverly, there is such free drainage through the underlying gravel. The project was subdivided with a view to distribution by pipes, generally following the roadways, and the lot boundaries were governed in part by topography, which accounts for their irregular areas.

The delivery line is 26 in. wood stave pipe for a distance of 3502 ft. from the plant to Beverly avenue. This is continuous stave pipe, made in place. From this point 24 in. machine-banded wood pipe runs west and 10 in. machine-banded pipe runs east. There are four main lines, running north on Riverside, Central, Chewanah and Terrace Drives, these being roads extending approximately parallel to the river, the last named being the highest. These lines vary in size, diminishing as they progress northward, being 16, 14, 10 and 8 inches in diameter. The laterals are mostly 6 in. and 4 in. machine-banded pipe, 4 in. being the smallest used on the system. There are altogether 12 miles of wood pipe, all machine-banded except the 26 in.; it was furnished by the Washington Pipe & Foundry Company, Tacoma, Wash.

The 12 in. branch to the reservoir joins the 26 in. line 933 ft. from the pumping plant, and extends thence 2210 ft. in a general northerly and easterly direction to the gate valve at reservoir.

The tracts into which the project is divided, run usually from six to twelve acres in area, though there are some larger ones and a few smaller. Water is led by the distribution system to the highest point of each lot and delivered through a 3 in. wrought iron pipe, rising vertically with an ell on top, the outlet being about 18 in. above surface of the ground.

The typical outlet branch is laid out as follows: A saddle is strapped on the wood pipe, and from the saddle a 4 in. machine-banded wood pipe runs near the riser pipe, terminating at a 4-in.-3-in. reducer, from which a 3 in. wrought iron pipe runs to a 3 in. gate valve. Following the gate valve, with nipple between, is an elbow from which the 3 in. riser conducts the water above the surface. Over the gate valve a 12 in. wood stave pipe is placed, its top projecting a few inches above ground.

Springing into being as a helper engine terminal for the Milwaukee's long grade, it is now possible to forecast Beverly's position as the trade center of a large and fertile region, of which the project herein described is the nucleus.

WIRELESS TO TELL THE EXACT TIME.

The exact time at a given moment in America and Europe will be established shortly by wireless telegraphy. About the middle of November it will be possible for the first time to establish with precision the longitudes of America and Europe in their relation to each other by the exchange of wireless signals between the great station at Arlington, Va., and the Eiffel tower in Paris, and other European stations.

Hitherto European and American time has been established by cable, allowances being made for loss of time in transmission, and it has been fixed only three times—in 1866, 1870 and 1872.

ELECTRICAL PUMPING AND IRRIGATION

PLANNING AN IRRIGATION SYSTEM.

BY B. A. ETCHEVERRY

I.—Preliminary investigations to determine feasibility of system.

The character of these investigations consists of a study of the land, the water supply, the crops and the cost of the system. In some cases the investigations will include a field hydrographic survey and reconnoissance, or even preliminary surveys. The investigations must be as thorough as the importance of the project will justify, but as the feasibility of the project is not at first known, the expenses must be kept down to a minimum.

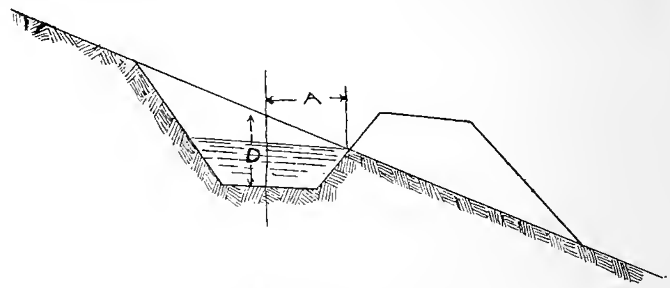
II. Alignment and location of diversion line and headworks.

This will include the following surveys: (1) Reconnoisance survey and trial line surveys; (2) Preliminary survey; (3) Location survey.

Reconnoissance survey and trial line survey. The purpose of these surveys is to determine the possible position of the headworks and the probable position of one or more diversion lines and their relation to the irrigable area. The final selection of the best diversion line in some cases requires the more detailed and accurate preliminary surveys of several of the favorable positions. Where topographic maps are available, such as the U. S. G. S. maps, the reconnoissance survey may not be necessary, and the most favorable position may be found from the map. But even then a rapid trial line survey is usually necessary. The reconnoissance survey will consist of a rapid survey of the various possible lines, in which are taken the elevation, distances and bearings. The elevations are obtained with aneroid barometers, distances are usually measured by stepping and the bearings by a compass. The reconnoissance may be followed by a more accurate trial line survey with level and transit and stadia. Where the character of the country is such that the probable position of the diversion line is pretty definitely indicated, the reconnoissance survey may not be necessary and a few trial lines will give the necessary information to select the best line. In addition to the survey notes the field book should contain general information as regards the character of material in which the canal will be excavated, the slope of the hillsides, the obstructions such as depressions, ridges, etc.

Preliminary survey—The purpose of the preliminary survey is to locate on the ground, as close as possible the diversion canal. This may be done in different ways, depending on the character of the country, (1) by a series of tangents with topography taken for a strip of land on each side, followed by a paper location; (2) by a series of tangents fitted to the ground with the necessary curves without the paper location. The second method differs from the first in that the preliminary survey is combined with the location survey and eliminates the paper location.

The first method of preliminary survey requires a level party and either a transit party or a plane table party. The level party works ahead of the transit or plane table party, setting stakes 300 or 400 ft. apart, or closer if necessary. The stakes are set on the center line of the canal allowing for the grade and for the depth of center cut. The distances which are necessary to obtain the canal grades are obtained sufficiently close by pacing. The depth of center cuts are obtained from diagrams or tables prepared for this purpose and which are kept by the rodman. The level party should carry the grade elevations on profile paper. The center cuts which are given for various slopes of ground may be computed on the basis that the amount of cut will equal the fill which brings part of the water section in fill; or it may be computed so that the water will be all in cut. This is safer on side hills especially, but gives an excess of material for the banks. To use the proper center cut from the tables, the slope at right angles to the canal is obtained by taking rod readings on points 50 to 100 ft. apart on each side of the canal or by using a clinometer carried by the rodmen. The method of computing center cut is described later.



Profile of Ditch With Water Section Entirely in Excavated Earth.

Where the water is to be kept all in cut, instead of using the computed center cut, the center line may be staked out without tables as follows: Locate the stakes at the point where the ground surface and the water surface on the downstream side intersect, the elevation of these points being at a height above the bottom of canal equal to the depth of water in the canal; from each of these points measure horizontally a distance equal to half the width of the canal at the water surface driving the center line stake on the other end of this measured distance.

Where the center cut must be such that the cut will balance the fill, the pivotal point method, used on reclamation projects in Montana and described later, is good.

The transit or plane table party follows the level party, locates the stakes, reads the distances by stadia and takes topography for a strip of land on each side of the level line of sufficient extent to include the final location. When a transit is used, the topography may be taken either by transit and stadia or by topographers using a hand level or clinometer. The level party must not work too far ahead of the transit party in order that the errors made in estimating the distances on which the allowance for grade is made will not become too large.

The results obtained are mapped and the final location made on the map and transferred to the ground.

The second method of preliminary survey combines the preliminary survey and field location survey and is well adapted to rough country. It has the advantage that it fits the canal to the irregularities of the ground very closely. For this method the work

Hillside Ditch Construction.

of the level party is the same as for the first method described above, except that the grade stakes are located at every station (measured by stepping) and at every controlling point. This work is important and it may be better for the chief of party to act as rodman.

The transit party carries tables of tangent offsets, external secants, semi-tangent lengths, etc. The locating engineer runs tangents which will fit the stakes or flags set by the level party, straightening out the irregularities, moving as many stakes above the new lines as below it so as to keep the proper balance between cut and fill within the limit of economic haul. Stakes are set 50 ft. apart and the head chainman proceeds until he comes to the P. I., which is selected by the chief of the party, by sighting along the approximate position of the tangent ahead. From the central angle and the lay of the ground the transitman selects the degree of the curve; the semi-tangents are then measured off, the P. C., and P. T. are set and the curve is run by tangent offsets.

The final profiles of the stakes set by the transit party are taken by the level party, which may be the same level party that proceeded the transit party or a second level party, when the transit work can keep up sufficiently close to the level party ahead. In taking the final profile, all depressions and also the slope of the ground at right angles to the canal line are recorded in the notes. The final profile and alignment are turned over to the field draftsman and estimates worked up. This will serve as a basis to let contracts until the line is cross sectioned.

The locating engineer should select the most economical and best location for structures and make notes as regards the best type of structure. Special topography is taken at these points. Where ridges or depressions must be crossed or where a saving in length may be obtained by not following the contour, profiles of the different lines and sufficient topography must be taken to select the most economical construction.

The character of the material must be determined by test pits or borings; for this a testing party may be necessary.

Paper location and field location survey—When the second method of preliminary survey is used it combines with it the field location. The paper location is therefore omitted. When the first method of preliminary survey is adopted the paper location is made aftei the preliminary line with the topography has been plotted. The paper location will be made by adjusting the tangents and curves to the topography; also by a study of the map and profiles of the trial lines placed on the map, so as to obtain the required amount of excavation, which may be the amount necessary to balance the fill, or the amount necessary to bring the water section all in cut, depending on the form of construction adopted.

The field location consists in staking out the center line of the paper location. The transit party stakes out the tangents introducing curves and ties in with the preliminary line at the intersections. The level party follows the transit party and runs a profile of the center line. From this profile and the elevation of the grade line,, the depth of cuts or fills are obtained and the line is ready for the cross sectioning of the construction survey.

III. Location of distribution system.

The location of the distribution system is generally preceded by a trial line survey of the upper boundary line of the irrigable area, which will probably be the position of the main canal, and of the lines on the ridges which the main laterals will probably occupy. This survey is mainly to determine the general feasibility of the distribution system. To plan the system it is best to have a complete topographical contour of the entire irrigable area. The topographical survey is usually based on one of the three following systems: (1) a triangulation system consisting of a base line carefully measured and of controlling points forming a system of triangles which will control the topographic survey; (2) a system of traverses run

Ditch Construction in Comparatively Level Country.

with transit and consisting of lines located on the upper boundary of the irrigable area on the ridges and drainage lines and connected by cross lines; (3) the U. S. land survey system. These three systems are only the skeleton controlling the topographic survey. When these systems have been established, lines of levels are run to obtain the elevation of each point. The details of the topography are obtained either with transit and stadia or with plane table; the latter is

usually preferable. The points of the system with their elevation are plotted on the plane table. Additional traverses are run where necessary and the topographic details located and plotted. The map should be made on a scale of not over 1000 ft. to the in. The contour intervals will depend on the character of the area. Where the slope is regular and fairly steep 5 to 10 feet is satisfactory. Where the slope is irregular with more or less knolls, or where the slope is flat, 1 foot contour interval is desirable.

The completed maps will give all the necessary information for the paper location of the distribution system and drainage system. Care must be used in laying out the system so that the water will be delivered at the highest point of each farm and if possible, at least 6 inches or 1 foot above this point. The laterals should all terminate in a waste or drainage channel. The paper location is followed by the field location, modifying the paper location where necessary. Levels are then run on the located lines and profiles plotted. With these profiles the cross sections, the grades, and the depth of cut, are adjusted to give the necessary cut and fill as explained later.

IV. Office work.

The office work will include:

1st. Design of canal sections and structures.

2d. Preparation of tables and diagrams for field work, such as tables of semi-tangent lengths; tables of tangent offsets, diagrams showing cross sections of canals with the yardage in embankment and in excavation for various slopes of hillsides; estimated cost per lineal foot of different forms of cross sections in different materials; of siphons, flumes and tunnels.

3d. Plotting of maps and profiles.

4th. Earthwork computations and cost.

5th. Bill of materials of structures and cost.

6th. Specifications.

V. Construction survey.

This includes the cross sectioning of lines, the staking out of earthwork and the location of structures.

References:

Topographical Surveys on the Canadian Pacific Ry. Irrig. Project, Eng. Record, Jan. 13, 1912.

Some methods and cost of contour surveying in winter, by H. G. Rashbacher, Engineering Record, Nov. 25, 1911.

Field Location of Canals for Engineers, Wisconsin Engineer, February, 1910.

Field Work in Locating Irrigating Ditch, Engineering News, May 26, 1910.

Canal Location in Uniform Countries, by Lyman E. Bishop, Proceedings of the Amer. Society of C. E., August 1911, October, 1911.

Methods and Cost of Making Sub-divisions on Topographical Survey for Sunnyside Unit, Washington Engineering Contracting, June 12, 1912.

Flow of Water in Irrigation Canals.

Velocity in canals—The principles of flow in canals are:

1st. In any canal where there is a uniform flow the two factors affecting the flow are the resistance of friction and the accelerating force; these two factors are equal, otherwise acceleration would occur.

2d. The resisting friction is proportional to the square of the velocity, the area of canal in contact with water, and the density of the liquid.

If F = Accelerating force parallel to canal grade.
F^1 = Friction resisting force.
S = Area of surface in contact with water.
d = Density of liquid.
p = Wetted perimeter.
a = Area of cross section. $\frac{a}{p}$ = hydraulic radius $= r$
l = Length of canal considered.
h = Fall in length l. W = Weight of water in length l.
C & C_1 = Constants. s = Grade.

Then $F^1 = CSdv^2$; But $S = pl$; therefore $F^1 = Cpldv^2$

$$\frac{F}{W} = \frac{h}{l} \text{ or } F = \frac{Wh}{l}. \text{ Since } F = F^1, \frac{Wh}{l} = Cpldv^2$$

$$\text{and } v^2 = \frac{Wh}{Cpl^2d}; \quad \text{But } W = ald, \text{ therefore } v^2 = \frac{aldh}{Cpl^2d} = \frac{1}{C}\frac{h}{l}\frac{a}{p};$$

$$v^2 = \frac{1}{C} Sr; \qquad v = \sqrt{\frac{1}{C}}\sqrt{rS} = C_1\sqrt{rS} \qquad \textit{(Chezy Formula)}$$

RESULTS OF THE CAREY ACT IN OREGON.

Admitting that so far Oregon's operations under the Carey act have not been very successful, the sixth biennial report of the Desert Land Board to the State Legislature has been completed and approved so far by the Governor, but has not been examined by all the other members of the Board. The report shows that a little over 500,000 acres of land in Oregon are now affected by the Carey act.

"Part of this land has been satisfactorily reclaimed, part is under contract for reclamation and part is temporarily withdrawn for investigation.

"The average value of this land, when irrigated, is at least \$30 an acre. If the Board succeeds in having all of this area reclaimed it will add \$15,000,000 in land to the taxable area of the state, besides bringing in a large number of people who will make their homes on these farms. Moreover, the state is entitled to an additional 500,000 acres of vacant desert land, under the Carey act," states the report.

"It must be admitted that Oregon's operations under the Carey act have not as yet been very successful. This is due to an unfortunate beginning. This state accepted the Carey act in 1901, but the act of acceptance did not give the State Land Board sufficient authority. Nearly all of our present projects were initiated between 1901 and 1905. There was no state engineer at that time to advise the Land Board relative to the engineering problems involved, and the parties initiating the projects did not seem to realize the importance of obtaining complete and reliable information relative to water supply, duty of water and cost of reclamation. The result was that the amount of available water was grossly overestimated, or the amount necessary to reclaim the land underestimated, or the cost of applying the water greatly underestimated.

"In 1909 the present law accepting the Carey act was passed placing the control of the Carey act lands in the Desert Land Board. It is believed that during the past two years the Board has been very successful in its efforts to readjust the earlier mistakes and that the Carey act projects of the state are now in better condition than ever before."

In its recommendation to the Legislature the Board asks for an appropriation of \$10,000. The report states that a competent engineer for field inspection and work should be in the steady employment of the Board.

RATE FIXING AND APPRAISAL

Rates of Return and Value.

BY C. L. CORY.

It is self-evident and repeatedly expounded that in the determination of reasonable rates of service, both the reasonable rate of return, including interest and profit and a fair valuation of the property used and useful in the service of the public, must be established.

As indicating some of the elements entering into the determination of what is a reasonable rate of return, reference is here made to the report in 1911 of the Railroad Securities Commission, of which President Hadley of Yale University was chairman. What is said there regarding the railroads of the country applies equally to all public utility enterprises.

"We hear much about a reasonable return on capital. A reasonable return is one which, under honest accounting and responsible management, will attract the amount of investor's money needed for the development of our railroad facilities. More than this is an unnecessary public burden. Less than this means a check to railroad construction and to the development of traffic.

"In no event can we expect railroads to be developed merely to pay their owners such a return as they could have obtained by the purchase of investment securities which do not involve the hazards of construction or risks of operation.

"Your commission recommends that the Interstate Commerce Commission should have authority and adequate funds to make a valuation of the physical property of railroads wherever the question of the present value of these roads is of sufficient importance. It is hardly necessary to add that your commission does not believe that the cost of reproduction of the physical properties, however carefully computed, is the sole element to be considered in determining the present value of a railroad, or that the outstanding securities could or should be made to conform to any such arbitrary standard.

"It is quite possible that the building of additional railroad mileage will be far less rapid in the future than it has been in the past, but the capital needed for the development and the improvement of the mileage already existing is enormous, even if we built no new mileage at all. Neither the rate of return actually raised on the par value of American railroad bonds and stocks today, nor the security which can be offered in the future will make it easy to raise the needed amount of capital."

Although you are familiar with the decision of Justice Peckham of the United States Supreme Court in the case of the Consolidated Gas Company of New York, reference is also here made to the following extract from this decision, as having unquestionably the most direct application to the rate of return for gas companies in large cities, although the question in this case was not the determination of the reasonable rate of return, but rather whether or not a certain rate of return would be enough to avoid the charge of confiscation.

"There is no particular rate of compensation which must in all cases and in all parts of the country be regarded as sufficient for capital invested in business enterprises. Such compensation must depend greatly upon circumstances and locality; among other things, the amount of risk in the business is a most important factor, as well as the locality where the business is conducted and the rate expected and usually realized there upon investments of a somewhat similar nature with regard to the risk attending them. There may be other matters which in some cases might also be properly taken into account in determining the rate which an investor might properly expect or hope to receive, and which he would be entitled to, without legislative interference. The less risk, the less right to any unusual returns upon the investments. One who invests his money in a business of a somewhat hazardous character is very properly held to have the right to a larger return, without legislative interference, than can be be obtained from an investment in government bonds or other perfectly safe security. The man that invested in gas stock in 1823 had a right to look for and obtain, if possible, a much greater rate upon his investment than he who invested in such property in the city of New York years after the risk and danger involved had been entirely eliminated.

" In an investment in a gas company, such as complainants, the risk is reduced almost to a minimum. It is a corporation which, in fact, as the court below remarks, monopolizes the gas service of the largest city in America, and is secure against competition under the circumstances in which it is placed, because it is a proposition almost unthinkable that the city of New York would, for purposes of making competition, permit the streets of the city to be again torn up in order to allow the mains of another company to be laid all through them to supply gas which the present company can adequately supply. And so far as it is given us to look into the future, it seems as certain as anything of such a nature can be, that the demand for gas will increase, and, at the reduced price, increase to a considerable extent. An interest in such a business is as near a safe and secure investment as can be imagined with regard to any private manufacturing business, although it is recognized, at the same time, that there is a possible element of risk, even in such a business. The court below regarded it as the most favorably situated gas business in America, and added that all gas business in inherently subject to many of the vicissitudes of manufacturing."

It may be of value to indicate some of the factors entering into the determination of a fair return upon capital invested in public utility companies and also to enumerate specifically some of the risks to which the investment in many public utilities are constantly subject.

The return upon the investment required by a public utility corporation is itself the sum of four elements, the first three pertaining to what is generally known as interest and the fourth as profit, as follows:

(1) Rental on money thoroughly well secured;
(2) Insurance to cover risk of loss;
(3) General expense involved in obtaining money and providing for periods of idleness when such money is not invested;
(4) The return to the owners of the property for their proprietary supervision and initiative actions, which return is true profit.

In any given community the rate of interest varies mainly because of variations in items (2) and (3). If

money absolutely secured against loss commands 5 per cent, item (1) is 5 per cent. If the insurance risk is 1 per cent, and if the cost of obtaining the money is 1 per cent, the total interest rate is 7 per cent. The farther a property is from the large money markets, the larger do items (2) and (3) become. Hence mere interest rates on the Pacific Coast are considerably higher than in the East.

The item of risk (2) rises as the amount loaned becomes a higher percentage of the value of the security. If the money can be borrowed at 7 per cent on a loan that is, say, three-fourths the market value of the property, there is a margin of security in the remaining fourth that has operated to reduce the item of risk, (2). If, however, it is desired to borrow money up to the full market value of the property, 8 per cent or more may be the interest rate, for item (2) has necessarily become greater.

It will be noted that nearly every loaner of capital assumes some risk, and charges interest rates accordingly. The borrower who uses the capital assumes the risk of being able to earn a profit, but his risk is provided for in the percentage of gross earning that it is estimated he should earn.

It has sometimes been asserted that there is practically no risk either on the part of the loaner of capital or on the part of the owner who uses the capital to build and operate a public utility. However, there are few utilities that are operated without risk. Twenty odd years ago gas lighting companies seemed to be safe against losses, but electric lighting has been developed to such a degree that many gas companies are not earning bare interest rates on the cost of their property. There is, in fact, no plant on earth that is safe from possible loss of earning power, so long as inventive genius exists and continues active, for a new invention may, at any moment, change completely an entire industry.

A public utility in a small town or city is subject to many risks, some of which it may be well to enumerate:

(1) Competition from other utilities whether privately or publicly owned.

(2) Stagnation in the growth of the town or city, causing loss of return on a plant built to provide for, and assist in, effecting growth.

(3) The passage of laws and ordinances injurious to existing business.

(4) Financial panics that deprive people of the means with which to pay for ordinary utility services.

(5) Great fires, floods, tornadoes, earthquakes, strikes, war, and other causes beyond the control of the utility company.

(6) Regrading of streets, extensive paving and other public expenditures, the burden of which a utility company must share either through direct assessment or through taxation.

These and other causes often make the risks of a utility company very considerable. The smaller the city or community, the greater the risk. Even when a public service commission fixes a rate of "fair return" the risk is not eliminated, for it may not be feasible to secure a fair return.

In recognition of all these things, the tendency of public service commissions and of courts has been toward allowing higher rates of return than were at first regarded as sufficient for a public utility to earn.

Judicial and commission decisions consistently and repeatedly rendered, have established the soundness of the principle, and the necessity, that the "value" of any enterprise of any character must include, in addition to the physical property actually used and useful in rendering service, the "going value" or the "value of the going concern." Such intangible value over and above the physical value may be referred to by a number of different names, but in every case, it is to be considered as the difference between the value of a physically complete and practically perfect plant or system ready for operation but not in operation, ready to give service but not giving service, ready to earn an income, but actually earning no income whatsoever, ready to enter into long or short term contracts with customers or consumers, but actually having no contracts of any kind with any consumers, at the end of the construction period but as yet with no business at all, and the value of this plant at some later time when business has been developed and perhaps firmly and permanently established, with many contracts, some for long terms and of greater or less value, with customers connected and receiving and paying for service, possibly in a progressive territory where the enterprise in question has in the past assisted, and is at present assisting materially in the general advancement of the community.

Viewed from a different standpoint, it may be supposed that the owners of such an enterprise are willing but are not compelled to sell, and a prospective purchaser is desirous, but not forced to buy the plant, system and business. Then the amount which such a prospective purchaser would pay the owners over and above the value of the physical property only, is unquestionably the going value of the enterprise. While the above statement must unquestionably be accepted as having been actually confirmed in numerour transactions, it is difficult in most instances to establish sound principles which may, with confidence and fairness, be used to determine in definite figures the going value of an enterprise and particularly of a public service corporation under the control of any public rate fixing (and quality of service) commission.

One element of going value which is quite generally accepted is the "Cost of Developing Business" or the "Development Expense," and if the aggregate of the various items, which are properly a part of the development expense, is not inconsistent with the value of the business actually obtained and held by the company, then the going value and development expense have a close relation in actual figures one with the other.

But it must be remembered that "cost" and "value" are not necessarily equal. "Cost" may be greater than "value" under disadvantageous conditions while "value" may be, and often is, many times the "cost" under decidedly favorable conditions. But if sufficient data and records are available in any given case, so that the development expense can be reasonably accurately obtained, and the management has been to a large degree wise and economical and good judgment has been shown, there is probably no more accurate or fair method available to obtain the "going value"

than its determination from the actual cost of building up and establishing the business.

The items which properly should be included in the development expenses are:

1. The difference if any between a "fair return" on the "value" of the property during the first years of its existence, or during the development period, and the actual return, tabulated by years and until such time as it may be said that the business is established to such a degree as to be earning a fair return on the investment, including the interest which the business has failed to earn, taking each year by itself.

2. All actual costs directly related to the securing of business such as advertising soliciting, unremunerative concessions to prospective customers, such as gifts, selling accessories below cost, maintenance of amusement parks to increase business, providing, of course, such costs are **bona fide** expenses over and above the **direct** revenue which may be obtained therefrom.

3. The cost of developing a competent business organization for the purpose of developing business, but this cost must not also be included in the general annual cost of maintenance and operation.

4. All the expense in the past history of the company which has been necessary and unavoidable in modifying the character of the system as a result of rapid changes in the art or abnormal growth of demand for service and which were required for the most economical operation and growth of the business, unless all such expense has been previously taken care of by an annual allowance for depreciation, obsolescence and inadequacy resulting from such modifications of the system.

Where a public utility enterprise has a number of departments such as electric light and power, gas and electric railway service, it would seem best in computing the development expense to consider each department separately from the time service was first given in each department, but in applying the final aggregate of all departments, if there should be a surplus in one or more departments, such surplus might be very properly considered as off-setting or tending to balance the inadequate return in one or more of the other departments.

In my opinion the statement that past "deficits" in the operation of the business should be combined and used as a measure of the "going value" is not only unfortunate, but decidedly misleading. Interest during the construction period might quite as properly be termed a "deficit" in return on the investment during the construction period, because the money expended during the construction period does not earn ordinary rates of interest during the construction period.

During the development of business period, the difference between a fair return and the actual return cannot properly be called a "deficit," but represents in reality an additional sum which investors should be prepared to put into the enterprise, over and above the cost of the physical plant, and continue to do so until the system is firmly established and consists of two main parts—the physical plant and the business actually being done at a real profit over and above legitimate maintenance and operating costs.

The word "deficit," while undoubtedly it should not be so interpreted, is unquestionably many times understood as implying uneconomical and unwise management, or the lack of reasonable foresight and good judgment, both of which qualities should be possessed to a considerable degree by those in control of all public utilities upon which the people are compelled to depend for proper and reasonable service at rates as low as are consistent with all the existing conditions.

It is, therefore, in some instances preferable to avoid the use of the word "deficit" in connection with "development expense," and obtain the going value by assuming that all expenditures in developing the business up to the time that a fair return is earned on the investment, should be added to the physical value of the system in order to arrive at the total value of the entire system in successful operation as a going concern, giving satisfactory service to its customers.

Necessary expenditures to develop business bear identically the same relation to the development period as interest during construction bears to the construction period.

THE ECONOMY OF CORPORATIONS.

BY JOHN OTTO.[1]

Down at the root of the things which make for the economic management of our public service corporations, and giving them one of their greatest advantages over municipal enterprises, is their ability to purchase material for construction, maintenance and operation cheaper than the same commodities can be purchased by untrained and short-termed political office-seekers. Ask the bonding companies for the percentage of corporation purchasing agents who have been delinquent in their accounts or have accepted money or its equivalent with whom they have had dealings, and they will tell you that the total of dishonest buyers for corporations is but a small percentage of the whole.

The purchasing agent of the corporation usually begins his career in minor positions of his employer and by the slow processes of loyalty, honesty, integrity, and ability which result in recognition, reaches a point where his employer is willing and warranted in entrusting him with the purchasing of millions of dollars worth of material and in relying absolutely upon his judgment.

Among the duties of the purchasing agent is to be reasonably familiar with every class of material which is required by his company, relying upon the opinion and recommendations of the engineers as to technicalities. This is an undertaking which requires constant vigilance with a company where ramifications of its purchases reach into the millions.

A purchasing agent for a company of this size and character must, to a certain extent, have a general knowledge of all the material in the market for which he has occasion to buy. He should know, for instance, the product of timber, wire and cables, poles, crossarms, transformers, meters, etc.

It is necessary for the purchasing agent to know the trend of the market on copper and its products, thus making it necessary for him to keep in touch with the market quotations on the raw material, also to keep himself advised as to the output of the mines, and the total consumption of finished product and the amount of raw material carried in the market. To illustrate: We purchased in November last two million pounds

[1]Purchasing agent, Southern California Edison Company.

of No. 4/0 stranded copper wire at approximately $14.25, whereas at the present time we would have to pay about $18.25. About the same time this order was placed several other orders were placed in this country and in Europe for like amounts, which, coming as they did when the copper market had been quiet, caused by inactivity in the electrical industry, at once caused prices to advance.

The above will show how necessary it is for the purchasing agent to keep himself posted on the prevailing market conditions.

In the placing of orders price does not always govern, as quality is the first thing to be considered. The second matter of importance is delivery. For instance, if an important extension had been passed upon and the operating department had been instructed to see that this work be started and finished at the earliest possible date in order to enable us to take on a very attractive piece of business, we would be largely

John Otto.

swayed in the placing of orders for the necessary material by the delivery we could secure. We might receive a quotation from some Eastern concern where the price would be, say, $100 less than we could purchase the same material for in the local market, but it might not be advisable to take advantage of the Eastern price for the reason that the amount involved would be so small as compared with what the revenue would be to the company and the good-will the consumers would have for us by virtue of our promptness in serving them.

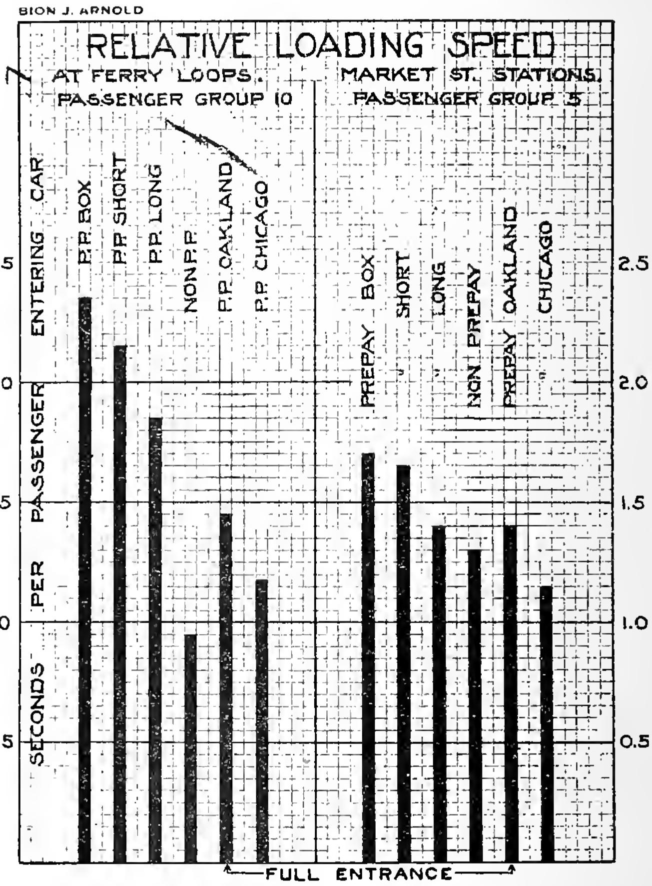
On the other hand, the purchasing agent of the municipal plant might be governed more or less by henchmen or political influences, and it could hardly be expected of him to show the same interest, as one associated with a corporation where the officials and department heads work in unison and harmony for the upbuilding and solidity of the company of which they consider themselves a part. If this spirit did not obtain it would seem to me impossible to build up the very large interests that are so numerous in this country, which all demonstrates beyond a doubt that where these influences are so prominent success will, of necessity, be the result.

SAN FRANCISCO'S TRANSPORTATION PROBLEM.

Relief of Traffic Congestion on Lower Market Street.

Bion J. Arnold's Preliminary Report No. 6 to the San Francisco Board of Supervisors is devoted to a consideration of ways and means for the immediate relief of the traffic congestion on lower Market street.

Detailed consideration is given to the following subjects: Traffic regulation; car and passenger distribution; location and sources of transit delays; street capacity; loading speed; physical obstructions; intersecting lines; arrangement of tracks; safety stations; assignment of stops, present, proposed and alternative; shelters; ferry loop traffic.



This report relates to the physical conditions and the operative problems only, and has no bearing whatever upon any question of franchises or litigation involving the outer tracks in lower Market street.

Summary of Recommendations.

Encourage and extend the work of the traffic force.

Reserve, for heavy vehicle traffic, one street through the Mission parallel to Market street, and one or more crossing Market street through the wholesale district.

Right-of-way should be determined by relative amount of pedestrian and car traffic at important intersections.

Reduce car traffic crossing Market street throat during rush hours to a minimum, e. g., First street.

Average loading speed of cars must be increased.

Use both ends of the cars at the Ferry for loading, at least, during periods of maximum travel.

Rearrange safety stations with seats elsewhere than opposite entrances and exits.

Extend stations to accommodate two cars at designated points of heavy travel.

At the heaviest traffic points—Third street and Fourth street—two cars should berth and cross together, tandem fashion.

Establish only "near side" stops within the business district.

Distribute stops as uniformly as possible to permit rapid running.

Eliminate as many unnecessary or special stops as may be consistent with the varying local demands of passenger travel.

Out-bound stations are more necessary than inbound; the latter are only required within districts where ferry travel originates.

Avoid out-bound and in-bound stations located in opposition position.

Designate all stopping points definitely by fixed signs.

No considerable increase in the use of the inner tracks on Market street can be recommended under present conditions and routing.

Use of outer tracks should be limited to preserve the proper ratio of car traffic on inner and outer tracks. Minimum headway, 45 seconds.

Four-track plan A, best suited to immediate needs, is recommended.

Establish definite rules for stops with regard to cars passing on parallel tracks.

Commence proceedings for the recession of the protruding corner of Sacramento and East streets.

Water-front terminal will require modification to better fulfill the fluctuating demands of ferry traffic.

THE INDUSTRIAL ENGINEER.

BY A. J. TURNER.[1]

The question may be asked,—What is the field of the Industrial Engineer?

This query may be answered by calling attention to the marked advance made in engineering in the last ten years, calling for more branches and specialization. Hydroelectric plants, having large amounts of electric current to sell, brought into existence the "Industrial Engineer," whose duty it is to study all power requirements so as to secure customers, improve load factors on generating stations, and keep the power company and customer in close touch with each other, to the end that high efficiency may be maintained.

In studying conditions where power is being produced by a prospective customer, it is the duty of the industrial engineer to segregate all the items entering into the total cost for power produced, test the plant for variation in power demand, if necessary, and determine what load curve is to be expected for the class of work it is called upon to perform during its operating period. In this manner the actual and not supposed power cost is secured and substantial saving shown by the purchase of "Electric Service."

Take, for instance, the production engineer, who operates so successfully in the eastern states; he works in a similar field, subdividing each and every manufacturing cost with the direct object of eliminating all unnecessary duplication of operation and correction of losses. What the production engineer is to the large industrial concern, the industrial engineer is to the central station. To illustrate how cost per unit of produced power by an isolated plant must be determined, the different factors entering into the same are given as follows: Fuel, labor, repairs, water, lubricating oils, supplies, rent, interest, depreciation, insurance, fire, boiler and liability, and taxes.

[1]Industrial Engineer, Great Western Power Company.

Often, one reads of a plant producing a horsepower or a kilowatt hour for a fraction of a cent. It is true in most every case that this refers to the cost of fuel only, and only then on a full load rating of the plant. How much attention is paid to the character of load curve on the plant which determines the average power produced. The industrial engineer must study each of the above items, which have a direct bearing on the ultimate cost and may be discussed each in their exact relation.

Fuel—Fuel, the first item, varies in cost according to supply and demand, location and quantity. The variation in load on the prime mover changes the overall efficiency and requires a larger amount of fuel to be used.

Labor—Again the load factor enters into consideration and determines the unit cost of labor per horsepower. If the unit cost of labor at 100 per cent load factor is one cent at 50 per cent it would be two cents per horsepower hour.

Repairs—This item of repairs varies materially and is not usually kept as a separate charge in which case it does not appear in the total cost of power.

Water—The cost of a water supply, whether purchased or pumped, should be taken into account. If a well is bored and a pump installed the amount spent for it should be charged to plant cost.

Supplies—Supplies, lubricating oils, waste and special tools receive small attention and should be rightly charged to produced power.

Rent—The space occupied by the power plant bears a portion of the total rented or owned portion and is very seldom considered. How well this space could be used for manufacturing purposes and the added revenue is not considered, as it should be from an actual business standpoint.

Other Important Items.

Interest—The amount of money invested in the power plant should earn an amount equal to that which it would return if it were in bonds. In fact if used in another business it might return a better revenue.

Depreciation—The life of the plant in question may be anywhere from ten to twenty years and a certain sum of money should be put by each year so that at any given time there may be sufficient money in a fund to keep the original investment in tact.

Taxes and Insurance—These items are justly chargeable to the unit cost of power produced. Insurance may cover that due to fire, boiler and liability for accidents. These important items are considered as fixed charges and represent amounts as follows:

Interest	6 to 7 per cent on first cost of plant
Depreciation	5 to 8 per cent on first cost of plant
Maintenance	2 to 3 per cent on first cost of plant

Taxes and insurance	..1 to	2 per cent on first cost of plant
Liability insurance	...1 to	2 per cent on first cost of plant
		15 to 20 per cent on first cost of plant

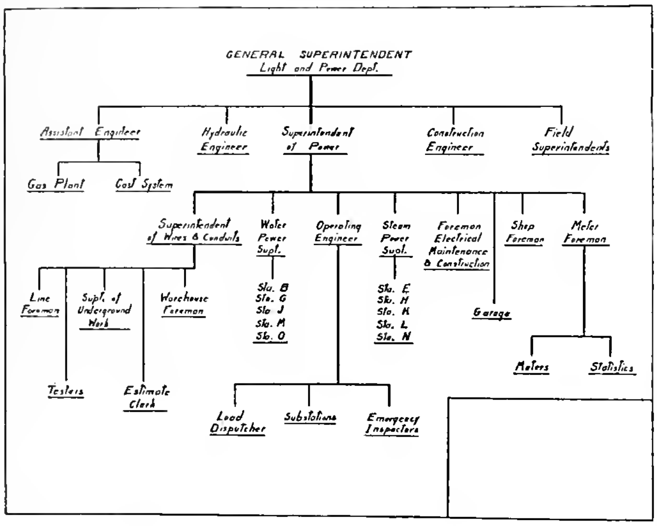
The above are not variables, but are constant, working each hour of the twenty-four in the day for the entire year.

When considered in terms of working hours, their importance will be admitted, as for instance, in an operation period of eight hours per day the fixed charges per unit of produced horsepower will be three times that of a plant operating twenty-four and others in proportion.

Few plants have a very good daily (24 hours) or operating time load factor, in which case the fixed charges per unit of horsepower is increased.

SCIENTIFIC ORGANIZATION OF POWER COMPANIES.

In the present day agitation looking toward maximum service at minimum cost the scientific organization of those making up the directing force is of paramount importance. The Northwest Light & Power Association through their committee on scientific operation of a central station has done much during the



Organization of the Portland Railway, Light & Power Company.

past few months to collect together material for future comparative study. The principles of efficiency are of small help unless there is an organization to carry them into effect.

The outlines of the organization of the companies represented bring out two different ideas.

In the one case the entire light and power department is in the hands of the general superintendent of light and power. He is reponsible directly to the president of the company for all construction, maintenance and operation of the light and power department. In the other case the engineering department under the chief engineer, has charge of the engineering part of the work, and reports directly to the president. By that arrangement the engineering department has full charge of the construction work of the company. In this plant, the operation of the system is under the direction of the superintendent of power, who reports to the general manager, and the general manager to the president. This form of organization draws a sharp line between construction and operation.

Among the advantages and disadvantages of each system may be mentioned the following points:

With one head there is a unity and strength that cannot be secured when the organization is divided; any two men are bound to have a variance of opinion at times, and there cannot help arising circumstances where there will be a difference between the two departments which would not occur if all were under one head.

On the other hand, the qualifications of a good construction man are quite different from those of a good operating man; the combination of qualities in one man is rare. The best operating men are those who, by long experience, are thoroughly familiar with the details of operation, are good judges of men, and have also the qualities of leadership and understand the prime essentials of economy and efficiency in the use of materials and men. The best construction men are those who have a good combination of energy, practical experience and training, and who have the special qualities required in engineers, of system, breadth of view and independence of thought, tempered with good judgment. Then, too, the methods of handling and requirements are so different in construction from those in operation that they have to be kept practically separate anyway. In the railroad business, the engineering department is almost always separate from the operating department.

In all the companies from which the statistics have been secured for this paper, the generation, transmission and transformation of power is in the hands of one man who is variously designated as superintendent of power or of stations.

In the Portland Railway, Light & Power Company the superintendent of power has charge also of the distribution, so that to him report all the men in the different processes of supplying the power from generation to point of consumption. To him report the superintendent of water power plants, the superintendent of steam power plants, the operating engineer, who has charge of the load dispatchers and the substations, the superintendent of wires and conduits, the shop foreman, the electrical construction foreman, the meter foreman and the foreman of the garage. He is practically superintendent of operation. The Portland system differs from the others in having a superintendent of water power plants and one for steam plants, instead of having the engineer of each plant report directly to the superintendent of stations. This plan has worked well in securing lower labor costs and satisfactory operation, as it makes possible the securing of men who, by long experience, are familiar with every phase of operation in their line.

There is not much difference between the various systems in the organization of the forces in the generating plants and substations. The Pacific Power & Light Company has a system that is different from the usual three shifts. A chief engineer is on duty for four hours, and two operators on duty ten hours each. The only objection to that arrangement would be the long hours the operators have to be on duty continuously.

ELEMENTS OF HYDRAULIC ENGINEERING

Francis Turbine Runners.

BY GEORGE J. HENRY, JR.

The unit speeds and capacities for Francis runners determine at once the class to which the runner belongs and the characteristics of the runner design.

It is obvious from what has gone before that the unit speed n_1 has the greatest effect upon the diameter and that the unit quantity Q_1 determines the area of the passageways; also with a given runner diameter that for different values of Q_1 we must have different widths of runner buckets or passageways.

It will be more convenient, however, to refer the runner design to the unit quantity Q_1, bearing in mind that the passageways must be provided for a water quantity such that when all allowances have been made for losses we must still have the requisite power output. If, therefore, we require a power output of H.P. under the head h, the same runner (by formulae 23) would give under 1 ft. head $H.P._1 = \frac{H.P.}{h^{3/2}}$, and if we put $H.P. = \frac{Q \times 62.4 \times h}{550} = 1$ if $h = I$ and Q_1 becomes $= \frac{550}{62.4} \times \frac{8.83}{\mu}$ (at 100% efficiency), or we may write $Q_1 = \frac{H.P._1 \times 8.83}{\mu} = \frac{H.P.}{h^{3/2}} \times \frac{8.83}{\mu}$ ....(27)

Where H.P. is the horsepower desired at head h and μ is the efficiency we propose to attain, then we must design the runner for Q_1 at unity head and with a corresponding n_1, already determined, we can at once by the curves in Fig. 26 select the proper runner.

The several types of runners may be classified for purposes of comparison as A, B, C, D, E and cross sections of these showing the water passages are shown in a general way in Fig. 27 to 31 inclusive.

The range of specific speeds and efficiencies that may safely be expected are also given and photographs of actual finished runners are shown in Figs. 32 and 33. The slow speed runner shown in Fig. 32 is that in use at the Borel Station of the Pacific Light & Power Corporation and is very similar to that in use in the Centerville Station of the Pacific Gas & Electric Corporation, while that shown in Fig 33 is for a high speed lower head unit. These show at a glance the wide range of design for which the Francis type of turbine is adopted.

Runners of the C. D, and E types may be made double over a large range, over which the speed and efficiency expectation remains the same which the Q_1 is doubled.

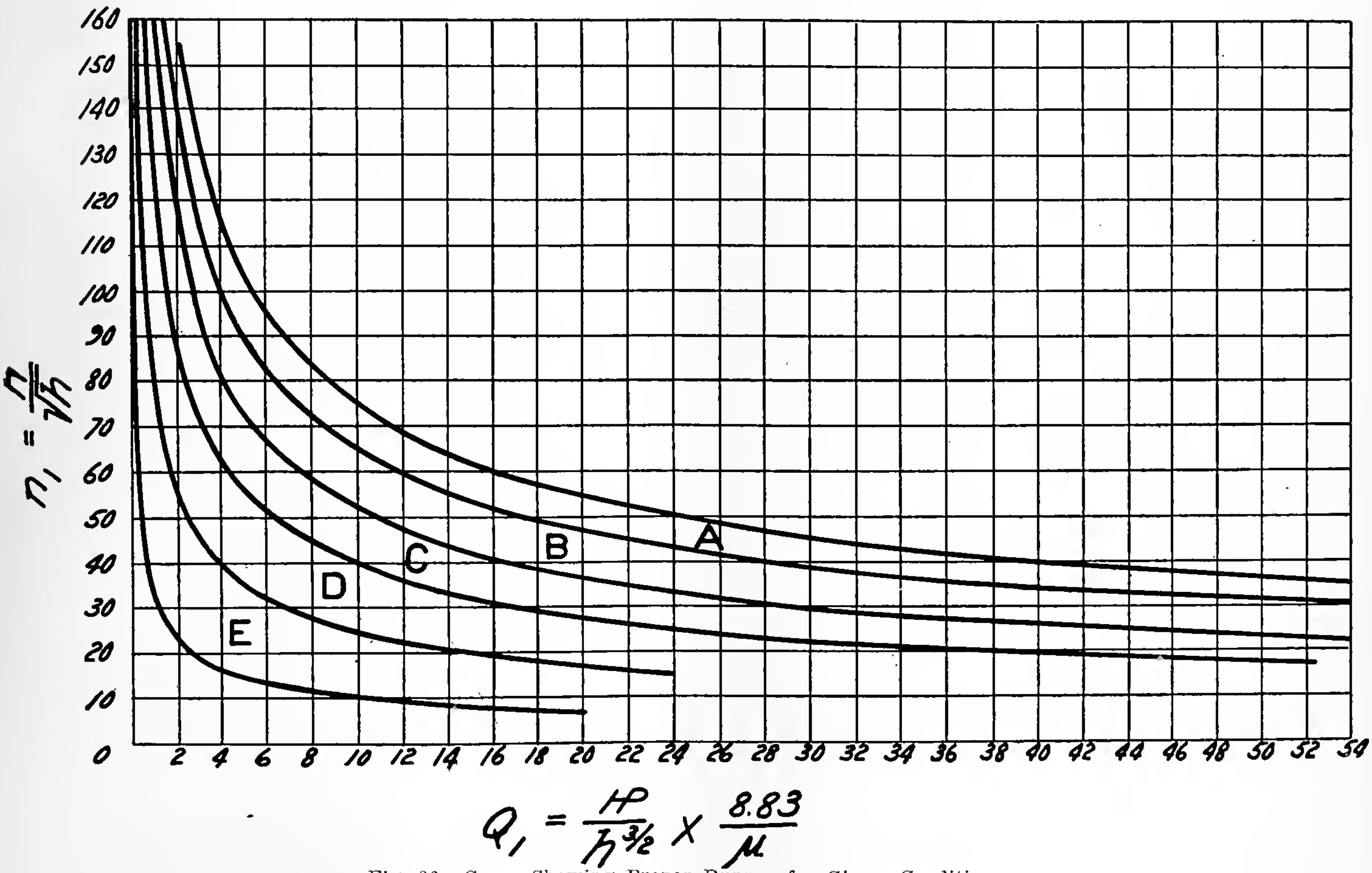


Fig. 26. Curve Showing Proper Runner for Given Conditions.

TABLE VI.

[Copyrighted by Geo. J. Henry, Jr., Mechanical and Hydraulic Engineer, Rialto Building, San Francisco]

Head or Pressure in feet	Pressure in lbs. per sq. in.	Spouting velocity in ft. per sec.	H. P. from 1 cu. ft. per sec. @ 80 % eff.	H. P. from 1 in. O jet @ 80% eff.	Rev. X Diam in inches running at 100% spouting vel.	Square Root of head in feet	Three halves power of head in feet	Five Fourths power of head in feet	Head in feet	Equivalent head in meter
h	p	$V_{sp}=8.025\sqrt{h}$	.09076h	$.00396h^{\frac{3}{2}}$	$1838\sqrt{h}$	$\sqrt{h}$	$h^{\frac{3}{2}}$	$h\sqrt[4]{h}=h^{\frac{5}{4}}$	h	h_m
1	.434	8.025	.0908	.0040	1838	1.000	1.	1.000	1	.3048
5	2.17	17.93	.4538	.0443	4110	2.236	11.18	7.474	5	1.52
10	4.34	25.38	.9076	.1252	5812	3.162	31.62	17.782	10	3.05
15	6.51	31.08	1.3614	.2297	7118	3.873	58.10	29.515	15	4.57
20	8.68	35.89	1.8150	.3544	8220	4.472	89.44	42.290	20	6.10
25	10.85	40.12	2.2689	.4950	9190	5.000	125.00	55.890	25	7.62
30	13.02	43.95	2.7227	.6507	10054	5.477	164.31	70.210	30	9.14
35	15.19	47.48	3.1763	.8222	10874	5.916	207.06	85.130	35	10.67
40	17.36	50.76	3.6302	1.002	11625	6.325	253.00	100.600	40	12.19
45	18.53	53.83	4.0842	1.196	12330	6.708	301.90	116.550	45	13.72
50	21.70	56.75	4.5380	1.400	12996	7.071	353.50	132.970	50	15.24
60	26.04	62.16	5.4455	1.841	14237	7.746	464.80	166.970	60	18.29
70	30.38	67.14	6.3515	2.471	15377	8.366	624.00	201.800	70	21.34
80	34.72	71.46	7.2608	2.837	16440	8.944	715.50	239.300	80	24.39
90	39.06	76.13	8.1640	3.387	17435	9.486	854.30	277.200	90	27.44
100	43.43	80.25	9.0764	3.961	18380	10.00	1000.0	318.2	100	30.48
110	47.80	84.18	9.9820	4.570	19282	10.49	1154.6	359.5	110	33.53
120	52.15	87.88	10.880	5.204	20128	10.95	1314.0	370.6	120	36.57
130	56.45	91.49	11.798	5.869	20953	11.40	1482.0	438.5	130	39.62
140	60.70	94.94	12.706	6.358	21745	11.83	1656.0	481.5	140	42.67
150	65.00	98.23	13.613	7.271	22498	12.24	1836.0	524.1	150	45.72
160	69.35	101.52	14.520	8.008	23251	12.65	2024.0	569.0	160	48.77
170	73.70	104.65	15.428	8.780	23969	13.04	2217.0	614.0	170	51.82
180	78.10	107.70	16.335	9.566	24668	13.42	2415.5	659.2	180	54.86
190	82.10	110.58	17.243	10.370	25330	13.78	2618.3	705.2	190	57.91
200	86.65	113.47	18.150	11.200	25990	14.14	2828.0	752.0	200	60.96
210	91.00	116.28	19.059	12.052	26634	14.49	3043.0	799.6	210	64.01
220	95.35	119.00	19.967	12.923	27260	14.83	3263.0	847.1	220	67.06
230	99.65	121.74	20.874	13.805	27883	15.17	3485.5	895.7	230	70.10
240	104.2	124.40	21.781	14.726	28472	15.49	3718.0	944.3	240	73.16
250	108.6	126.87	22.689	15.665	29060	15.81	3955.0	993.8	250	76.20
260	112.9	129.45	23.597	16.601	29630	16.12	4191.5	1043.8	260	79.25
270	117.2	131.85	24.503	17.570	30200	16.43	4436.0	1094.0	270	82.30
280	121.6	134.26	25.411	18.551	30751	16.73	4684.0	1145.0	280	85.35
290	126.0	136.67	26.318	19.562	31302	17.03	4938.5	1198.0	290	88.39
300	130.3	138.99	27.277	20.580	31836	17.32	5196.	1248.5	300	91.44
310	134.6	141.32	28.135	21.625	32369	17.61	5460.	1301.0	310	94.49
320	139.0	143.57	29.041	22.798	32882	17.89	5756.	1354.0	320	97.54
330	143.3	145.80	29.950	23.747	33398	18.17	5996.	1407.0	330	100.58
340	147.6	147.98	30.856	24.833	33894	18.44	6270.	1460.0	340	103.64
350	152.0	150.15	31.764	25.938	34390	18.71	6549.	1514.0	350	106.70
360	156.4	152.23	32.671	27.050	34868	18.97	6830.	1568.0	360	109.74
370	160.7	154.40	33.579	28.192	35364	19.24	7118.	1623.0	370	112.80
380	165.0	156.45	34.486	29.305	35823	19.49	7399.	1670.8	380	115.83
390	169.4	158.50	35.394	30.503	36302	19.75	7792.	1732.2	390	118.88
400	173.7	160.50	36.301	31.68	36760	20.00	8000.	1788.7	400	121.93
410	178.1	162.50	37.210	32.88	37220	20.25	8302.	1844.9	410	124.98
420	182.5	164.43	38.120	34.31	37660	20.49	8662.	1900.0	420	128.03
430	186.7	166.44	39.024	35.32	38140	20.74	8918.	1958.0	430	131.08
440	191.0	168.37	39.932	36.39	38562	20.98	9187.	2015.0	440	134.13
450	195.5	170.21	40.840	37.81	38984	21.21	9545.	2094.7	450	137.18
460	199.7	172.13	41.746	39.08	39425	21.45	9866.	2130.0	460	140.23
470	204.0	174.00	42.656	40.36	39849	21.68	10190.	2188.2	470	143.28
480	208.4	175.82	43.562	41.63	40271	21.91	10520.	2247.0	480	146.33
490	212.7	177.78	44.470	42.97	40605	22.14	10850.	2305.4	490	149.37
500	217.1	179.44	45.380	44.28	41100	22.36	11180.	2364.5	500	152.42
510	221.5	181 20	46.285	45.58	41500	22.58	11515.	2423.5	510	155.47
520	225.9	182.98	47.190	46.95	41905	22.80	11855..	2482.0	520	158.52
530	230.1	184.73	48.101	48.32	42310	23.02	12200.	2543.0	530	161.57
540	234.5	186.50	49.008	49.70	42715	23.24	12550.	2603.0	540	164.61
550	238.9	188.80	49.915	51.09	43100	23.45	12898.	2663.0	550	167.66
560	243.1	189.88	50.823	52.48	43489	23.66	13250.	2724.0	560	170.71
570	247.6	191.57	51.730	53.88	43873	23.87	13607.	2785.0	570	173.75
580	252.0	193.24	52.636	55.31	44260	24.08	13965.	2846.0	580	176.80
590	256.3	194.92	53.545	56.73	44645	24.29	14331.	2908.0	590	179.85
600	260.6	196.53	54.455	58.19	45014	24.49	14693.	2969.5	600	182.90
610	265.0	198.22	55.360	59.66	45400	24.70	15067.	3033.0	610	185.95
620	269.3	199.82	56.270	61.14	45768	24.90	15438.	3094.0	620	189.00
630	273.7	201.42	57.178	62.62	46135	25.10	15812.	3156.2	630	192.04
640	278.0	203.03	58.082	64.12	46500	25.30	16191.	3219.0	640	195.09
650	282.3	204.65	58.990	65.64	46870	25.50	16573.	3282.1	650	198.14
660	286.6	206.17	59.898	67.14	47218	25.69	16955.	3345.0	660	201.19
670	291.0	207.85	60.803	68.71	47568	25.88	17349.	3408.0	670	204.24
680	295.3	209.30	61.712	70.24	47935	26.08	17734.	3472.7	680	207.29
690	299.7	210.81	62.620	71.78	48285	26.27	18126.	3536.8	690	210.33
700	304.0	212.26	63.530	73.32	48615	26.45	18514.	3600.0	700	213.38
710	308.4	213.87	64.400	74.94	48984	26.65	18923.	3665.0	710	216.43
720	312.8	215.30	65.340	76.51	49313	26.83	19318.	3729.2	720	219.48
730	317.1	216.83	66.250	78.12	49662	27.02	19723.	3794.5	730	222.52
740	321.2	218.28	67.160	79.72	49993	27.20	20130.	3902.0	740	225.57
750	325.7	219.80	68.070	81.27	50342	27.39	20542.	3925.5	750	228.62
760	330.0	221.25	68.975	82.98	50675	27.57	20953.	3992.0	760	231.67
770	334.4	222.70	69.880	84.62	51004	27.75	21368.	4057.0	770	234.72
780	338.8	224.13	70.798	86.28	51336	27.93	21786.	4122.5	780	237.77
790	343.1	225.58	71.700	87.92	51633	28.11	22208.	4188.0	790	240.82
800	347.5	226.95	72.602	89.60	51979	28.28	22623.	4255.0	800	243.87
810	351.9	228.40	73.510	91.11	52308	28.46	23051.	4322.0	810	246.91
820	356.2	229.84	74.415	91.28	52640	28.64	23484.	4388.0	820	249.96
830	360.6	231.20	75.325	94.69	52952	28.81	23911.	4459.0	830	253.01
840	364.9	232.57	76.239	96.40	53264	28.98	24342.	4522.0	840	256.06
850	369.2	233.92	77.145	96.93	53578	29.15	24775.	4589.5	850	259.11
860	373.6	235.38	78.050	99.89	53908	29.33	25223.	4658.0	860	262.15
870	378.0	236.73	78.958	101.62	54220	29.50	25664.	4725.0	870	265.20
880	382.3	238.00	79.865	103.37	54517	29.66	26101.	4793.0	880	268.25
890	386.6	239.40	80.775	105.14	54829	29.83	26549.	4862.0	890	271.30
900	391.0	240.75	81.680	106.93	55140	30.00	27000.	4929.5	900	274.35
910	395.2	242.02	82.588	108.75	55435	30.16	27445.	5002.5	910	277.40
920	399.5	243.40	83.495	110.52	55745	30.33	27905.	5067.0	920	280.44
930	403.9	244.68	84.402	112.31	56035	30.49	28357.	5136.0	930	283.49
940	408.2	245.98	85.312	114.11	56328	30.65	28812.	5204.0	940	286.54

TABLE VI.

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Head or Pressure in feet	Pressure in lbs. per sq. in.	Spouting velocity in ft. per sec.	H. P. from 1 cu. ft. per sec. @ 80 % eff.	H. P. from 1 in. O jet @ 80% eff.	Rev. X Diam. in inches running at 100% spouting vel.	Square Root of head in feet	Three Halves power of head in feet	Five Fourths power of head in feet	Head in feet	Equivalent head in meter
h	p	$V_{sp}=8.025\sqrt{h}$	.09076h	$.00396h^{\frac{3}{2}}$	$1838\sqrt{h}$	$\sqrt{h}$	$h^{\frac{3}{2}}$	$h\sqrt[4]{h}=h^{\frac{5}{4}}$	h	h_m
950	412.6	247.32	86.22	115.97	56660	30.82	29280.	5273.	950	289.6
960	416.9	248.61	87.13	117.80	56950	30.98	29742.	5343.	960	292.6
970	421.2	249.9	88.03	119.61	57250	31.14	30202.	5412.	970	295.7
980	426.6	251.18	88.94	121.49	57550	31.30	30675.	5483.	980	298.7
990	430.0	252.48	89.85	123.36	57840	31.46	31145.	5553.	990	301.8
1000	434.3	253.75	90.76	125.20	58140	31.62	31620.	5623.	1000	304.8
1020	444.0	256.32	92.58	129.03	58700	31.94	32579.	5764.	1020	310.9
1040	452.0	258.8	94.39	131.56	59275	32.25	33218.	5907.	1040	317.0
1060	460.0	261.38	96.20	136.80	59840	32.56	34512.	6048.	1060	323.1
1080	468.5	263.70	98.01	140.57	60400	32.86	35490.	6190.	1080	329.2
1100	478.0	266.20	99.82	144.52	60920	33.17	36489.	6335.	1100	335.3
1120	486.5	268.60	101.64	148.49	61510	33.47	37489.	6478.	1120	341.4
1140	495.0	270.91	103.46	152.29	62060	33.76	38450.	6622.	1140	347.5
1160	503.5	273.31	105.28	156.49	62600	34.06	39510.	6770.	1160	353.6
1180	512.0	275.65	107.20	160.55	63140	34.35	40539.	6915.	1180	359.7
1200	521.0	277.99	108.90	164.65	63670	34.64	41571.	7062.	1200	365.8
1220	529.5	280.31	110.72	168.78	64200	34.93	42617.	7210.	1220	371.9
1240	538.0	282.56	112.55	172.92	64730	35.21	43663.	7358.	1240	378.0
1260	547.0	285.20	114.36	177.35	65240	35.54	44782.	7510.	1260	384.0
1286	555.5	287.12	116.17	181.42	65757	35.78	45805.	7656.	1280	390.1
1300	564.5	289.39	117.99	185.68	66270	36.06	46880.	7806.	1300	396.2
1320	572.5	291.54	119.80	189.95	66780	36.33	47960.	7956.	1320	402.3
1340	581.5	293.80	121.61	194.31	67280	36.61	49060.	8108.	1340	408.4
1360	590.5	295.95	123.43	201.96	67780	36.88	50899.	8258.	1360	414.5
1380	599.0	298.11	125.25	203.07	68280	37.15	51270.	8410.	1380	420.6
1400	607.0	300.30	127.06	207.50	68780	37.42	52393.	8563.	1400	426.7
1420	616.0	302.39	128.88	212.04	69260	37.68	53540.	8715.	1420	432.8
1440	625.0	304.55	130.70	216.37	69743	37.95	54630.	8870.	1440	438.9
1460	634.0	306.63	132.50	220.96	70230	38.21	55789.	9022.	1460	445.0
1480	642.5	308.71	134.33	225.30	70710	38.47	56883.	9180.	1480	451.1
1500	651.0	310.80	136.15	229.92	71190	38.73	58045.	9334.	1500	457.2
1520	659.5	312.89	137.95	234.52	71660	38.99	59210.	9490.	1520	463.3
1540	668.0	314.90	139.77	239.34	72130	39.24	60433.	9631.	1540	469.4
1560	677.0	317.00	141.60	244.08	72600	39.50	61622.	9803.	1560	475.5
1580	686.0	319.00	143.40	248.77	73058	39.75	62803.	9960.	1580	481.6
1600	694.5	321.00	145.21	253.48	73520	40.00	64000.	10120.	1600	487.7
1620	703.0	323.00	147.03	258.25	73975	40.25	65203.	10275.	1620	493.8
1640	712.0	325.00	148.85	263.06	74435	40.50	66420.	10457.	1640	499.9
1660	720.5	326.92	150.66	267.84	74885	40.74	67630.	10595.	1660	506.0
1680	729.0	328.93	152.48	272.77	75340	40.99	68865.	10756.	1680	512.1
1700	737.0	330.85	154.30	277.61	75780	41.23	70090.	10917.	1700	518.2
1720	746.0	332.79	156.10	282.50	76220	41.47	71330.	11076.	1720	524.2
1740	755.0	334.72	157.92	287.45	76670	41.71	72575.	11237.	1740	530.3
1760	763.5	336.65	159.74	292.41	77103	41.95	73832.	11400.	1760	536.4
1780	772.0	338.58	161.55	297.45	77540	42.19	75100.	11560.	1780	542.5
1800	780.0	340.51	163.66	302.47	77975	42.43	76374.	11720.	1800	548.6
1820	789.0	342.35	165.18	307.50	78410	42.66	77640.	11886.	1820	554.7
1840	798.0	344.29	167.00	312.63	78840	42.90	78935.	12052.	1840	560.8
1860	806.5	346.13	168.81	317.43	79270	43.13	80145.	12215.	1860	567.0
1880	815.0	347.98	170.63	322.85	79700	43.36	81520.	12360.	1880	573.0
1900	824.0	349.93	172.45	328.00	80120	43.59	82820.	12543.	1900	579.1
1920	832.5	351.66	174.26	332.88	80540	43.82	84050	12710.	1920	585.2
1940	841.0	353.51	176.08	338.46	80960	44.05	85460.	12876.	1940	591.3
1960	850.0	355.29	177.89	343.65	81380	44.27	86770.	13040.	1960	597.4
1980	859.0	357.12	179.70	348.97	81780	44.50	88110.	13208.	1980	603.5
2000	866.5	358.89	181.52	354.22	82196	44.72	89440.	13374.	2000	609.6
2020	876.0	360.66	183.32	359.52	82603	44.94	90780.	13540.	2020	615.7
2040	885.5	362.50	185.15	364.91	83015	45.17	92140.	13709.	2040	621.8
2060	893.0	364.27	186.96	370.30	83420	45.39	93500.	13878.	2060	627.9
2080	902.5	366.02	188.78	375.70	83825	45.61	94860.	14047.	2080	634.0
2100	910.0	367.80	190.60	381.30	84230	45.83	96245.	14085.	2100	640.1
2120	919.0	369.49	192.41	386.55	84630	46.04	97605.	14385.	2120	646.2
2140	928.0	371.25	194.22	392.06	85030	46.26	98990.	14558.	2140	652.3
2160	936.5	373.00	196.04	397.60	85430	46.48	100380.	14728.	2160	658.4
2180	945.0	374.70	197.86	403.05	85820	46.69	101777.	14896.	2180	664.5
2200	953.5	376.40	199.68	408.65	86220	46.90	103180.	15066.	2200	670.6
2220	962.5	378.15	201.50	414.28	86610	47.12	104609.	15238.	2220	676.6
2240	971.0	379.85	203.30	419.80	86986	47.33	106020.	15420.	2240	682.8
2260	979.5	381.51	205.12	425.48	87375	47.54	107440.	15581.	2260	688.9
2280	988.5	383.00	206.94	431.10	87760	47.75	108860.	15754.	2280	695.0
2300	996.5	384.90	208.75	436.80	88150	47.96	110300.	15928.	2300	701.0
2320	1007.	386.58	210.56	442.50	88530	48.17	111740.	16100.	2320	707.2
2340	1016.	388.18	212.38	448.15	88910	48.37	113170.	16369.	2340	713.2
2360	1025.	389.87	214.20	454.00	89290	48.58	114640.	16450.	2360	719.4
2380	1033.	391.95	216.00	459.40	89670	48.79	116000.	16623.	2380	725.4
2400	1042.	393.15	217.82	465.60	90050	48.99	117575.	16775.	2400	731.5
2420	1051.	394.78	219.63	471.40	90420	49.19	119040.	16966.	2420	737.6
2440	1059.	396.45	221.46	477.35	90800	49.40	120540.	17150.	2440	743.7
2460	1068.	398.05	223.27	483.04	91160	49.60	122010.	17327.	2460	749.8
2480	1077.	399.68	225.10	489.07	91540	49.80	123500.	17501.	2480	755.9
2500	1086.	401.25	226.90	495.00	91895	50.00	125000.	17678.	2500	762.0
2520	1094.	402.85	228.71	500.95	92260	50.20	126500.	17852.	2520	768.1
2540	1103.	404.46	230.52	506.90	92630	50.40	128000.	18030.	2540	774.2
2560	1112.	406.07	232.34	513.00	92955	50.60	129530.	18218.	2560	780.2
2580	1120.	407.59	234.16	518.95	93380	50.79	131040.	18385.	2580	786.4
2600	1129.	409.20	235.97	524.95	93720	50.99	132540.	18564.	2600	792.5
2640	1146.	412.32	239.60	534.85	94460	51.38	135064.	18924.	2640	804.7
2680	1164.	415.45	243.23	549.50	95150	51.77	138750.	19285.	2680	816.9
2720	1181.	418.50	246.87	562.25	95860	52.15	141980.	19644.	2720	829.0
2760	1199	421.64	250.50	574.20	96560	52.54	145000.	20005.	2760	841.2
2800	1216.	424.68	254.12	586.80	97255	52.92	148175.	20370.	2800	853.4
2840	1233.	427.65	257.76	599.35	97400	53.29	151330.	20730.	2840	865.6
2880	1250.	430.70	261.39	612.10	98635	53.67	154570.	21100.	2880	877.8
2920	1268.	433.68	265.00	621.90	99320	54.01	157800.	21464.	2920	890.0
2960	1285.	436.63	268.64	637.95	100000	54.41	161080.	21836.	2960	902.2
3000	1303.	439.53	272.29	650.65	100667	51.77	164310.	22203.	3000	914.4
3200	1390.	447.00	290.43	717.28	103970	56.57	181200.	24070.	3200	975.3
3400	1476.	468.00	308.58	785.25	107170	58.31	198280.	25963.	3400	1036.4
3600	1563.	481.50	326.71	854.70	110280	60.00	216000.	27886.	3600	1097.4
3800	1650.	494.33	344.90	927.60	113300	61.64	234230.	29833.	3800	1158.3

Types of Francis Turbine Runners	A	B	C	D	E
Range Spec Speed	68 – 80	50 – 68	38 – 50	24 – 38	10 – 24
Range Rim Speed	79 – 82	73 – 79	68 – 73	64 – 68	60 – 64
Range n_1	32 – 155	26 – 160	20 – 160	15 – 160	15 – 160
Range Q_1	2 – 50+	1.25 – 45+	0.8 – 40+	0.5 – 38	0.3 – 22
Efficiency	Full Gate – 72% 3/4 Gate – 75% 1/2 Gate – 68%	Full Gate – 77% 3/4 Gate – 79% 1/2 Gate – 73%	Full Gate – 80% 3/4 Gate – 82% 1/2 Gate – 76%	Full Gate – 81% 3/4 Gate – 83% 1/2 Gate – 77%	Full Gate – 80% 3/4 Gate – 82% 1/2 Gate – 76%

Fig. 27-31. Cross Sections and Water Passages of Various Runners.

The Application of Formulae.

Many of the formulae that have been heretofore given, involve the use of constants which may be readily tabulated for particular use; and to facilitate calculations a slide rule determination of the more important constants applicable to heads from 1 ft. to

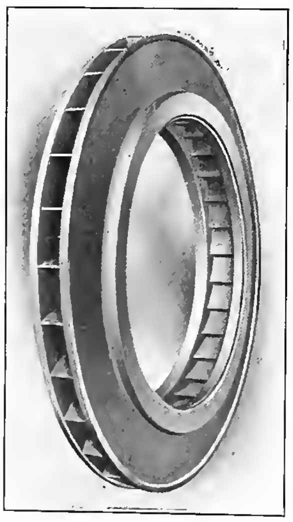

Fig. 32. Slow Speed Runner.

3800 ft. and .33 meters to 1153.3 meters is given in table VI.

Column 1 and column 10 give the head in feet.

Column 2 the equivalent pressure in pounds per sq. in.

Column 3 the spouting velocity in feet per second.

Column 4 is useful in determining the horsepower available (at 80 per cent efficiency) from any given number of cubic feet per second for any given head

$$H.P._{80} = Q \times \text{Const.} \quad \text{.......................... (28)}$$

and the Quantity in cubic feet per second necessary for the production of a required horsepower (assuming 80 per cent efficiency).

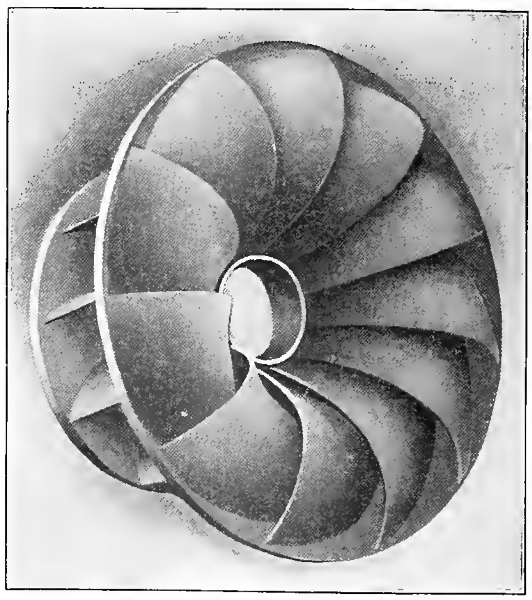

Fig. 33. High Speed Lower Head Runner.

$$\text{is } Q = \frac{H.P._{80}}{\text{Const.}} \quad \text{.......................... (29)}$$

Column 5 gives at once the horsepower from any size jet or the jet diameter for any requisite horsepower (assuming 80 per cent efficiency) by the formulae

$$H.P. = \text{Const.} \times \text{jet diameter}^2 \quad \text{.............. (30)}$$

$$\text{jet diameter} = \sqrt{\frac{\text{H.P.}}{\text{Const.}}} \quad \dots\dots\dots\dots (31)$$

Column 6. The constants here given are the product of the revolutions and diameter of runners if running at 100 per cent of the spouting velocity therefore we should correct the constant found in this column by an appropriate valve from table IV and we may then write

$N \times D_p = \text{Const.}$ (from table IV) $\times$ per cent of spouting velocity at which the pitch circle is to run, placing these values

$= K_c$ and per cent V_{sp} respectively we may write

$$n = \frac{K_c \times \text{per cent } V_{sp}}{D_p} \quad \dots\dots\dots\dots (32)$$

$$D_p = \frac{K_c \times \text{per cent } V_{sp}}{n} \quad \dots\dots\dots\dots (33)$$

Column 7 is particularly useful in determining speeds under unity head for comparisons under different heads, as we have seen that speeds vary as the square root of the heads and that

$$n_1 = \frac{n}{\sqrt{h}} \quad \dots\dots\dots\dots (34)$$

and we may write $\dfrac{n_{11}}{n_{111}} = \dfrac{\sqrt{h_{11}}}{\sqrt{h_{111}}}$ $\dots\dots\dots\dots (35)$

where n_{11} and n_{111} are the speeds of the same wheel under heads of h_{11} and h_{111} respectively.

Column 8 is useful in making comparisons of energy outputs under different heads or unity head, for (by formula 26).

$$\text{H.P.}_1 = \frac{\text{H.P.}}{h^{3/2}} \quad \dots\dots\dots\dots (26)$$

and we also write by proportion

$$\frac{\text{H.P.}_{11}}{\text{H.P.}_{111}} = \frac{h_{11}^{3/2}}{h_{111}^{3/2}} \quad \dots\dots\dots\dots (36)$$

Column 9 is for determination of specific speeds.

$$S = \frac{n\sqrt{\text{H.P.}}}{h^{5/4}} \quad \dots\dots\dots\dots (25)$$

Column 11 gives the head in meters equivalent to the heads in feet in columns 1 and 10.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

October 21.

A decision was rendered providing for a reduction in the wholesale rate on electric power sold by the Snow Mountain Water and Power Company to the Napa Valley Electric Company. The order puts into effect a reduction from an average of 1.81 cents per kilowatt hour to a rate varying from 1 cent to 1.25 cents per kilowatt hour, and the Commission states that it expects the Napa Valley Electric Company to reflect this decrease in lower rates to its consumers.

An order was issued calling upon the electric railroads of the State to furnish necessary inventories and statements to enable the Commission to proceed with the appraisement of their properties.

October 22.

Decision was rendered in the case of the City of Pasadena versus the Southern California Edison Company, in which the former had complained that the latter had reduced its rate in Pasadena to a point which made impossible the profitable operation of the municipal lighting plant of Pasadena. The City of Pasadena charged discrimination and asked that the Southern California Edison Company be compelled to raise its rate in Pasadena. In its decision the Commission sustains the objection raised by the Southern California Edison Company, that the City of Pasadena itself has the power to fix rates within its limits, and such power does not rest with the Railroad Commission. The Commission suggests that the issue may be presented by a complaint from the unincorporated territory charging discrimination.

October 25.

A decision was rendered granting authority to the Sutter Butte Canal Company to issue $52,000 in bonds for refunding purposes, and to issue $197,000 of promissory notes in exchange for outstanding certificates of indebtedness.

A decision was rendered granting permission to the San Jose Terminal Railway Company to issue $400,000 of bonds, to be used for the construction of an electric railway between San Jose and Alviso, and for the establishment of a boat service between Alviso and San Francisco.

The Commission is preparing a uniform system of accounts and classifications for gas companies and for electric companies, which will be printed as soon as possible and distributed to interested parties.

October 29.

A decision was rendered granting permission to the Coast Valleys Gas & Electric Company to take over the property of the King City Water, Light & Power Company.

L. W. Warmoth applied to the Commission for permission to sell his telephone line extending from Corning in Tehama County, to Newville, in Glenn County, to the Pacific Telephone & Telegraph Company.

October 31.

The Commission rendered a decision granting permission to R. H. Gaud to transfer a street railway franchise in Santa Barbara to the Santa Barbara & Suburban Railway Company and has authorized the Santa Barbara and Suburban to exercise the franchise rights thereby granted. The decision requires that the stock of the company be not transferred. The Commission states that the franchise should have provided for a more liberal application of reduced fares for school children.

An order was issued granting permission to the Coast Counties Gas & Electric Company to purchase the Davenport Light & Power Company, of Santa Cruz County.

JAPANESE IMPERIAL GAS ASSOCIATION.

The rapid increase in the number of gas companies in Japan has led to the formation of an Imperial Gas Association, with headquarters at Tokyo, T. Takamatsu being president. There are about 60 member companies and about 40 more companies in the process of formation. The association has taken over the Gas Journal, "Gas Kai," and will publish it under their own auspices.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

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E. B. STRONG, President and General Manager
A. H. HALLORAN, V. P. and Managing Editor
ROBERT SIBLEY, Treasurer and Editor in Chief
C. L. CORY, Secretary and Special Contributor
A. M. HUNT, Director and Special Contributor

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The Financial Outlook

The past week, typical of human life, was ushered in with hope and promise in the bosoms of three national figures. Then came the great voice of the people in utterance of thoughtful expression. The vote is cast; the result is heralded with joy throughout the nation—joy to the victor's friends for in it they see a popular expression, unmistakable in its endorsement of the attributes they themselves see in their leader; joy to the friends of the vanquished, for in it they see the cessation of months of strenuous, earnest work and inwardly feel that self-satisfaction incident upon a battle well-fought.

Through all the turbulent months, the old ship of state has rolled on serene in its majesty. Never before has a presidential election been so little reflected in the industry and activity of the nation. Indicative of this supreme indifference to the political situation, the recently compiled data of the bureau of railway economics presents interesting figures.

For instance data on file with the Interstate Commerce Commission show that the net earnings for August of this year—the latest month available for complete information—shows larger footing than for any preceding August—so large in fact that the month of October, 1909, is the only month on record excelling in this excellent tabulation.

From every quarter come reports that the manufacturer of electrical supplies is overburdened with early deliveries. Such a state of affairs augurs well for the concentrated effort now being planned by all affiliated electrical organizations to place the standard of accomplishment even still higher in 1913. So strenuous and so successful have been these past campaigns however, the onlookers may truly say—as did the Kansas farmer, speculating as to whether the Lord was with him, when he was safely deported by the whirlwind into the next county: "Well, if he ware, he certainly ware a-goin some."

To the unexcelled workers for the aggrandizement of electrical appliances, strength to your strong right arm!

The Element of Risk

In any reasonable determination of what is justice in a controversy between both parties to an issue, it must be admitted that the view points of both parties should be carefully investigated. This, for instance, is the sole basis upon which equitable rates may be established for the public utility company. Such a method of procedure leads inevitably to the conclusion that the rates charged by a utility company must not be greater than the service is worth to the customer, and must not be less than sufficient to yield a fair or reasonable return to such public utility company.

The complete control of a public utility by a just and legally constituted regulating commission is undoubtedly the solution of a former perplexing problem. Under

this new regime sinking funds are established to take care of depreciation and obsolescence. In addition to the accumulation of such funds a reasonable return is then allowed for the invested capital. Since the public does not guarantee this return, however, there is unquestionably a risk—at times, indeed a risk of such proportions that the utility may become swamped or bankrupt. It is said that depreciation and obsolescence funds should care for all possible contingencies. Yet we challenge the man to come forth and say accurately what the next twenty years—yes even the next ten years may bring forth. Each day are brought to light new inventions. Let a single brilliant thought be attuned to apply solar radiation under carefully planned energy storage to human needs of cooking and heating the home. What a tremendous curtailing of power consumption would instantly arise. Seven thousand horsepower per acre eternally dissipated in sunny climes is indeed a fruitful field for inventive thought.

But in the computation of engineering risks we can only foretell the future by what has happened in the past, and hence the present depreciation and obsolescence funds. The investor, however, is curtailed by the commission in putting a limit to his return, thus dooming him to ruin in case of an unforseen cheaper supply of energy being made possible by invention. In theory the mode of procedure is correct, yet in view of events which have happened in the past, something more should be provided for the investor than commending his case in the event of a new invention, to a wise and far-seeing providence. This statement may be ahead of its time but we state that in the highest evolution of regulation in which the return on invested money is kept at a minimum, the investor should be guaranteed against such an unforseen event, for it is a possible contingency which may arise. Indeed if such an unforseen event should materialize, the people at large could well afford to compensate the former faithful servant in view of the tremendous gain realized from the innovation.

Scientific Organization of Power Companies

Two factors seem paramount in bringing about efficiency in economic evolution of the modern central station—the one relates to the general scheme of organization management and the other to the scientific development of the commercial side of the power output. It is evident that the highest development of the first mentioned factor would practically produce the power product at a minimum cost, while the latter factor, in its highest development, would dispose of this product under the most advantageous commercial return to the company.

Let us for the moment consider one phase of the organization management now in force among Western hydroelectric companies. Two conflicting methods are found in the control of that department generally entitled "Light and Power" or its equivalent. One method calls for a single head whose duty it is to superintend all construction, maintenance and operation. Such a person, solely responsible to the president of the corporation, has the direction of the engineering force in new construction as well as the keeping intact of the work already completed, including the actual operation of the various plants. On the other hand, in many other companies the custom long tried and approved in the great railway organizations of the country is enforced—namely, the segregation of new construction from that of maintenance and operation of the plants. And, well may these functions be segregated, except in cases of extreme rareness. Seldom do we find in the human make-up the requisite traits combining both functions of management necessitated. A casual study into the characteristics of human beings brings to light that certain of us are born with ideas of constructive imagination, enthusiasm for creating new work under new and untried conditions, an enthusiasm which sweeps all before it. On the other hand, another group of equally powerful, action-creating minds exists, whose natural endowment makes them leaders among men, leaders in the use of men and economy in operation. In a word, the one group are experts in bringing to life new layouts, while the latter are experts in keeping alive, under the most economic methods, what the former group create. It would seem, then, unless the central station is fortunate in possessing the man who has this most unusual combination of mental equipment, that the most efficient scheme is brought about by dividing the duties falling under the light and power department or its equivalent, into two separate groups, each on a par and each reporting directly to the president.

Returning now to a discussion of the second topic in the opening paragraph, let us consider one phase of organization today, which is materially aiding many of the large central stations of the west to dispose of their product under the most advantageous commercial return to the company. The most forceful reflective thought which dawns upon the student of central station economics, as he delves into its various ramifications, is that by no means is the most profitable load the one which, as a rule, brings the highest gross return. So varying and many-sided is this subject that some of the larger companies have created a separate department of experts whose duty it is to consider as industrial engineers the most profitable methods of readjusting the present connected load. Even deeper study than this is made of the correct and uniform method of connecting up new consumers at prices satisfactory to the consumer and profitable to the central station. But the greatest good that arrives from the creation of such a department is that it imposes a special function upon the industrial engineer—that of looking afield and developing new applications for electrical energy. The cut-throat policy of taking from a competitor a load, which at best is but returning a meager profit, is suicidal. But on the other hand, the central station, presuming the policy of prying into new fields, suggesting to new groups of industries new and enlarged uses of electrical energy, is indeed the modern industrial general who, like Alexander the great, will triumph over all obstacles and some day have that unique privilege of sighing because of a scarcity of more worlds to conquer.

PERSONALS.

Rudolph W. Van Norden, consulting engineer, spent the past week at Lake Spalding and Nevada City, Cal.

F K. Lane, secretary and general manager of the Seattle Light Company of Seattle, Washington, is at San Francisco.

F. S. Pratt, vice-president of the Stone & Webster Corporation, who has been at Seattle recently, has left for Boston.

W H. Shepard and **Allen G. Jones** have returned to the San Francisco offices of the General Electric Company from the East.

James S. Thompson, salesmanager of the McGraw-Hill Book Company, publishers of technical books, is a recent San Francisco visitor.

Sidney Sprout, consulting engineer, is inspecting the construction work of the California-Oregon Power Company's system in Northern California.

F. D. Nims, electrical engineer with the Western Canada Power Company, Ltd., of Vancouver, B. C., has been appointed Jovian Statesman for British Columbia.

John Coffee Hays, president, and **S. L. Stovall,** hydraulic engineer, with the Mt. Whitney Power Company of Visalia, California, were at San Francisco this week.

Benjamin C. Holst, district manager of the Northern Electric & Manufacturing Company, Ltd., of Vancouver, B. C., is making a two months' business trip throughout the East.

C. B. Nicholls, who has been representing the engineering department of H. M. Byllesby & Company in the Tacoma office has been transferred to the engineering department at Chicago.

Delos F. Wilcox has been at San Francisco during the past week as advisor to the Supervisors with regard to the proposed charter amendment relating to street railway franchises.

W. L. Goodwin, general manager of the Pacific States Electric Company, is at Seattle in connection with the establishment of a Seattle branch of the Pacific States Electric Company.

H. S. Wells, new business manager for the Pacific Power & Light Company. has refurned to Portland, Oregon, after attending a meeting of the N. E. L. A. Committee on Electricity on the Farm, called by Chairman **S. V. Walton** at San Francisco.

Frederick H. Newell, director of the government reclamation works, has been making a tour of the western irrigation projects and closely investigating conditions. In Boise, Idaho, the evennig of October 24 he spoke to the engineers of the state upon the work the government is doing.

H. N. Lauritzen, Pacific Coast manager for the Nelite Works of the General Electric Company, has returned to San Francisco after a three weeks' trip throughout the Northwest and Denver. The San Francisco headquarters of the Nelite Works have been established at 86 Third street.

Herbert Gates has succeeded to H. W. Clapp's position with the electrical department of the Southern Pacific Company and **W. C. Myers** has been transferred from the West Alameda shops to succeed B. C. Edgar, Mr. Clapp and Mr. Edgar now being with the Columbus Railway and Light Company, as announced in these columns last week.

Samuel Kahn has been appointed assistant to Elmer Dover in the operation of the western properties of H. M. Byllesby & Company. This group includes the Oregon Power Company, Northern Idaho & Montana Power Company, the Tacoma Gas Company, the Everett Gas Company and the Western States Gas & Electric Company. Mr. Kahn was formerly connected with the operating department at Chicago.

A. W. Leonard has been appointed general manager for the Puget Sound district of the Stone & Webster Corporation, succeeding the late R. T. Laffin; **H. T. Edgar,** manager of the Seattle division, has been promoted to the office of district manager in the Central Western States, with headquarters in Boston; and **A. L. Kempster,** superintendent of railways, has been promoted to the office of manager of the Seattle division with the title of general superintendent, in succession to Mr. Edgar

C. O. Mailloux, vice-president on international arrangements for the International Electrical Congress at San Francisco in 1915, is at San Francisco from New York City to consult with the exposition authorities and with **Henry A. Lardner,** vice-president on Pacific Coast relations. Shortly after his return to New York Mr. Mailloux will start for Europe with the authority of President Chas. C. Moore to extend invitations to foreign scientific and technical societies to attend the Congress.

OBITUARY.

The passing of Eugene R. Hallett, manager of Louis Sloss & Company of San Francisco, on Sunday evening, October 26, came as a severe shock not alone to his many personal friends but to all those handling western hydroelectric securities. In addition to his many regular managerial duties with his firm, Mr. Hallett published during the past year a book entitled "Public Utilities Act of California." This book gained a well-merited highly favorable comment from all quarters Mr. Hallett was a young man of high ideals, possessing an unusually keen business perception.

MEETING NOTICES.

Electrical Development League.

The Electrical Development League will meet at Tait's Cafe, San Francisco, at 12:15, Tuesday, November 30. W. A. Clowen, vice-president of the Pacific Surety Company, will talk on "Various Phases of the Roseberry Liability Insurance Law and Its Effect on the Employers of Labor."

Portland Section, A. I. E. E.

The next regular meeting of the Portland Section of the A. I. E. E. will be held in the Assembly Hall of the Electric Building at 8:00 p. m., sharp, November 19, 1912. A paper will be presented by W. D. Scott, engineer of the Pacific Telephone Company, on the subject of "Leased Wire Service on the Pacific Coast."

Los Angeles Section, A. I. E. E.

The Los Angeles Section of the American Institute of Electrical Engineers held its regular monthly meeting at Hotel Hollenbeck, on Tuesday evening, October 29, 1912, 65 members and visitors being present. President George A. Damon was in the chair. Professor Sorenson, chairman of the programme committee, announced that the subject for the November meeting would be "Illumination," by Professor Harris J. Ryan of Stanford University, California. Mr. Damon then introduced Mr. J. E. Macdonald, who read a paper entitled "Legislation vs. Regulation in Electrical Distribution." This paper was illustrated by lantern slides and was thoroughly discussed, by the following: E. R. Northmore, R. E. Cunningham, Berry, E. F. Scattergood, R. H. Manahan, H. B. Lynch, E. Y. Porter, F. B. Lewis, Harris, T. A. Panter.

TRADE NOTES.

Among recent orders received by the Westinghouse Electric and Manufacturing Company are reported the following: The British Columbia Electric Railway Company, Vancouver, B. C., for five 50-ton locomotives to be equipped with four No. 208B-3 motors and HB. control.

The California Oregon Power Company have made a contract with the Shasta Valley Irrigation Company to supply power for an irrigation pumping system to be installed near Montague, Cal. This will comprise a 6500 gallon pump raising about 112 feet and a 1250 gallon pump raising about 86 feet. The pumps will be Worthington, double-suction volute type. The constant speed motors have not yet been selected.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

SPECIFICATIONS FOR THE INSTALLATION OF MOVING PICTURE MACHINES AT PORTLAND, OREGON.

Compiled by F. D. Weber.

It is not only suggested, but strongly urged, that, wherever possible, the moving picture machine be located, not, as is usually the custom, at the entrance to the room, but at the end opposite to the entrance. Then in case of a fire which is not confined within the enclosure, the audience will not have to pass near the flames in leaving the theater.

Work and Appliances. All wiring, apparatus, etc., not specifically covered by special rules herein given must conform to the Standard Rules and Requirements of the National Electrical Code.

1. **Arc Lamp** used as part of moving picture machines and dissolvers, etc., must be constructed similar to arc lamps of theatres, so far as practicable as specified by the National Electrical Code, and the wiring of same must not be of less capacity than No. 6 B & S. gage copper wire.

2. **Wiring** must all be in approved rigid or flexible conduit (this includes booth, auditorium, dressing rooms or any part of moving picture theatre). See Rule 38, N. E. C. Ed. 1911. Each picture machine, dissolvers, flood or spot light must be wired as a 2-wire circuit, and a 2-pole switch and cut-out must cut off and protect the resistance and arc for every machine. All conduit must be brought to a point as near as possible to the arcs of the machines. Connections from arcs to conduit must be made with asbestos covered wire. Conduit must be rigidly supported in every case.

3. **Rheostats or Other Necessary Current Reducing Devices** must be made entirely of non-combustible material and of approved design. Must be mounted on non-combustible support in such a manner that there will be an air space of at least 3" on all sides. The rheostat must be of enclosed design or be completely enclosed by a netting with a mesh not greater than ½". When the resistance is not hung in operating room and the same is excessively hot, the same must be properly protected by asbestos. We strongly advise that resistances be suspended from the ceiling on strain insulators. When it is possible the resistance should be located outside booth.

4. **Top and Bottom Reels** must be enclosed in steel boxes or magazines, each with an opening of approved construction at bottom or top so arranged as not to permit entrance of flame to magazine. No solder is to be used in the construction of these magazines. The front side of each magazine must consist of a door spring hinged and swinging horizontally, and be provided with a substantial latch.

5. **Automatic Shutter** must be provided and must be so constructed as to shield the film from the beam of light whenever the film is not running at operating speed. Shutter must be permanently attached to the gate frame. In addition, a non-automatic shutter must be provided, placed in front of condenser so as to be readily closed by hand.

6. **Extra Films** must be kept in individual metal boxes equipped with tight-fitting covers.

7. **Machine Operation.** Must be operated by hand. (Motor-driven will not be permitted, except when moving picture machines of approved type are used.) If driven by a motor, moving picture machines must be of a type expressly designed and approved for such operation, and when so approved, motor-driven machines, when in charge of a skilled operator, may be permitted by the Inspection Department of this Bureau.

This permission must be given in writing by the Inspection Department.

8. **Reels Containing Films Under Examination or in Process of Rewinding** must be enclosed in magazines or approved metal boxes similar to those required for films in operation, and not more than 2 feet of film shall be exposed in booth.

9. **Picture Machines** must be placed in an **Enclosure or House** constructed in the following manner:

10. **Construction of Enclosure or House** (Booth).

(a) **Size of Booth.** All booths to be at least 6 feet 6 inches high, or high enough to provide space for gravity sliding doors, with floor space to vary according to the number of machines in booths, as follows:

One picture machine, 6x6 feet.

One picture machine and one stereopticon, 9x6 feet.

Two picture machines and one stereopticon 12x6 feet.

For every additional machine, 3 feet in width must be furnished.

(b) **Openings** per machine in the booth, one for the operator and one for the machine. Opening for machine shall not be more than 8 inches high and 12 inches long. Operator's window shall be not more than 8 inches wide and more than 12 inches high. All openings in other portions of booth, except ventilator in ceiling and entrance doors, must not exceed 8 inches wide and 12 inches high. All openings to this booth, excepting entrance doors to this enclosure or house, must be arranged so as to be entirely closed by doors or shutters constructed in the following manner: Doors must be hung so that gravity will tend to close them (only vertical sliding doors will be approved) and be held open by a twine arranged in such a way that it will pass directly over the film when in place. All doors over openings, except entrance doors, must be sliding doors, and be constructed of two pieces of No. 22 U. S. Standard gauge (.0313 inches) galvanized iron, one piece placed on each side of ¼-inch asbestos; lap 1 inch around the corners, and the whole riveted together. The doors to lap over all edges of openings at least 1½ inches. The same to run in galvanized iron guides of at least No. 16 U. S. Standard gauge (.0625 inches), the guides to lap over door at least 1 inch, and fit snugly against the openings covered. The guides to be placed inside of the booth and all the heads of nails or screws holding same in place to be concealed by a single lock formed on the guides. These guides to be continued across bottom of opening to form a seat for the door to drop into. Corners of guides to be lapped and riveted. Guides to be made with square corners and doors to be made with square edges so doors will not bind when operated. The sides of all openings must be lined to outside and lap at least 2 inches over the outside of booth.

(c) **Ventilation** must be obtained through the ceilings in all booths to the outside air, and no ventilator to be of smaller size than 36 square inches in cross section per machine. This ventilator to be constructed with lock joints or rivets, and solder not to be depended upon for holding sheets of metal in place. The gauge of metal to be the same as used in the construction of iron booths.

(d) **Entrance Doors** must close against an angle iron rabbit 1x1x$^3/_{16}$ inches, extending completely around openings, and be held closed by a metal rope and weight, the weight to run inside of protecting pipe, and the rope to pass over a pulley. This door when constructed of metal, must be constructed in a thoroughly substantial manner of equally as good fire resisting material as the booth itself and be braced so that same will not warp or get out of shape. When the door is constructed of wood and metal it must be constructed and hung according to the requirements of an approved

fire door. The size of the door shall not be larger than 2x6 feet.

(e) **Stationary Wooden Metal Lined Booth** to be constructed of sheating (ship-lap) at least ¾ inch thick, supported by 2x4-inch wooden studding, not more than 18-inch centers, presenting a smooth and solid surface on the inner side of booth. All studding, braces, etc., to be on the outside of booth. The ceiling and walls of booth must be lined with at least ⅛-inch asbestos under galvanized sheet iron as thick as No. 26 U. S. Standard gauge (.0188 inches), and the joints must be locked. The floor must be covered with galvanized sheet iron at least as thick as No. 22 U. S. Standard gauge (.0313 inches) sheet iron over a ⅛-inch asbestos . Metal must be thoroughly secured in position by nails and the heads covered by approved lock joint (see Figure 1), made with the metal lining of the booth. Entrance door openings must not be larger than 2x6 feet. All other openings must conform to section (b).

Note—Outside the city limits of Portland, Oregon, the ⅛-inch asbestos in section (e) may be omitted.

[To be continued.]

PROGRAM FOR ANNUAL CONVENTION OREGON ELECTRICAL CONTRACTORS' ASSOCIATION, PORTLAND, DEC. 10, 11, 1912.

Tuesday, December 10.—10:00 a. m., Convention called to order at Moose Hall, Seventh and Morrison streets. Address of Welcome; response by Mr. J. H. Ralston, President Oregon Electrical Contractors' Association. Papers: The Relation of the Oregon Electrical Contractor to the Underwriters' Inspection Work in Oregon, Mr. F. D. Weber, Inspector Underwriters' Equitable Rating Bureau. The Relation of the Electrical Jobber to the Electrical Contractor, Mr. F. N. Averill, Manager Fobes Supply Company. What the National Electrical Contractors' Association is doing for the Electrical Contractor, Mr. Geo. H. Duffield, Special Representative of the N. E. C. A. Some Practical Statements from a Central Station Expert, Mr. O. B. Coldwell, General Superintendent Power and Light Department Portland Railway, Light & Power Company. Credit—Its Utility in the Modern Commercial World, Mr. L. B. Smith, Manager Credit Department Fleischner Mayer Company. Costs and Efficiency, Mr. P. L. Procter, Manager Pacific Audit Company.

Wednesday, December 11th—Trip to Portland Railway, Light & Power Company's power plant at Cazadero. Electric train leaves corner of First and Alder at 9 a. m. sharp. Be sure to be on time and not miss this very interesting trip. Luncheon at Estacada Hotel. Return to Portland; on arrival association members will meet at the Convention Hall in the Electric Building, Seventh and Alder streets, and proceed to the election of officers for the ensuing year, and to transact any other association business. 8 p. m., banquet and entertainment at the Multnomah Hotel.

The present officers of the association are: President, Jos. H. Ralston, Albany, Oregon; Vice-President, W. O. Fouch, Portland, Oregon; Secretary, S. E. Kilkenny, St. Johns, Oregon; Treasurer, John R. Tomlinson, Portland, Oregon.

WAREHOUSE INSTALLATION AT PORTLAND.

An interesting lighting and power installation has just been completed in Portland in the new warehouse for the Honeyman Hardware Company, on Ninth and Hoyt streets. This splendid building, which is entirely of re-enforced concrete construction, covers 100 x 100 feet of ground space, and is seven stories in height with basement, and is used exclusively for warehouse purposes by the above-mentioned hardware firm.

The wiring installation is, of course, installed throughout in galvanized conduit, the total number of circuits being 185, or approximately 24 circuits per floor. The panel boards on each floor are fed separately from a switchboard located in the basement, which gives the engineer and the night watchman perfect control of all lighting and power in the building. In addition to the control mentioned, the entire lighting and power service is controlled by an 800 ampere T. P. remote control circuit breaker. This breaker is in turn controlled by tripping switches located at the two main entrances of the building, thus giving firemen control of all current in the building (except elevator power and fire escape lights) in case of fire, as required by city ordinance.

The lighting of the entire building is made complete by the installation of approximately 500 Benjamin reflector sockets of 16-inch diameter, equipped with 40-watt Mazda lamps on all floors except the first, where they are equipped with 60-watt lamps, on account of a higher ceiling and a greater demand for illumination.

Each outlet in this building is also equipped with a Bryant 2309 ceiling pull switch, making a most efficient installation in so far that each outlet may be controlled separately. This has already been found one of the best investments in the building, as, by the old methods, it was found that the employees were in the habit of leaving an entire circuit burning, whereas with this new arrangement, only one lamp can be left burning at the most. The mounting for these switches was accomplished by concealing double outlets in the concrete ceiling about 18 inches apart, using one for the fixture outlet and the other for the switch, which was mounted on closed covers with stove bolts. The building was designed by Architect D. C. Lewis, and the electrical layout was designed and installed by the West Coast Engineering Company, R. G. Littler manager, 708 Couch Building, Portland, Oregon.

NEW CATALOGUES.

A 120 page catalogue on Multi-Stage turbines is being distributed by the De Laval Steam Turbine Company of Trenton, N. J. It includes much information of value to steam users.

Bulletin No. 137 from the Electric Storage Battery Company of Philadelphia, entitled "Some Recent Developments in the Lead Battery for Electric Vehicles" describes a number of recent improvements in the "Ironclad Exide" battery.

Bulletin No. 45 from Byron Jackson Iron Works of San Francisco is devoted to Jackson 1912 direct connected centrifugal pumps. In addition to an illustrated description of the various types of pumps the bulletin includes tables on the friction of water in pipes, duty of water for irrigation and direction for installing and starting centrifugal pumps.

The Kellogg Switchboard & Supply Company are distributing a number of unique circulars and post cards, which bear considerable human interest. These include a handsome four-color reproduction of a pen etching by Valleby, entitled "Neighborhood News," with the Kellogg telephone as the center of attraction. Another card gives a neat rendition of "Humpty Dumpty" to prove the strength of the Kellogg telephone. "Railway Telephone Cards" is the subject of an attractive six-page folder demonstrating their long life and water-proof qualities. "A Long Distance Call" is the title of the fourth of this interesting series.

ELECTRICITY ON THE FARM.

Stanley V. Walton, western chairman of the National Electric Light Association Committee on Electricity on the Farm, called a meeting of the committee at San Francisco last week and made preliminary arrangements to issue a handbook on the subject which will be published by the Commercial Section of the Association. The next meeting of the committee will be held at Portland in December. Future meetings will be held at Denver and Los Angeles.

THE PROGRESSIVE SPIRIT.[1]

BY S. M. KENNEDY.

In these latter days, the word "Progressive" is dinned into our ears to such an extent that some people are liable to misunderstand its meaning, or else get absolutely tired of it. However, we of the electrical fraternity know that as progress leads to perfection the progressive spirit is something which should be cultivated by all connected with our most important industry.

Let us glance at the results of the progressive spirit on businesses which we might consider co-related to the one in which we are engaged. I refer particularly to transportation, the telegraph and the telephone. Transportation has, properly speaking, three divisions: land, water and air. Land transportation may be traced to the period when mothers first strapped their babies on their backs. Since that time, more patents have been issued upon inventions relating to transportation than upon any other line of human activity. They range all the way from a little device for unhitching a runaway horse, to the latest idea in guiding an automobile. Think what this wonderful development has meant for the civilized world; how it has linked country with country and brought nation close to nation, so that together they might move forward to fulfill their destinies.

Before we pass the subject of transportation, I want to say that the progressive spirit has commanded that the horse must soon go. Already he is considered slow, and that means the beginning of the end. The swift moving gasoline car began to drive the horse to the wall, but even the gasoline smell alone would not kill or displace him. No, it is the development of the silent, odorless, convenient and flexible electric vehicle that has commenced pushing the horse back to the farm. Watch the electric wagon progress from this time on. Watch the streets of our city become clean, quiet and orderly. Watch the electric move the passengers and freight about the streets of Los Angeles. In five years from now, even the vegetable Chinaman will run an auto, and your children's children will have to go to a menagerie to see specimens of the once loved horse.

I am a believer in the future of the electric vehicle. Each month it asserts itself a little stronger. Not for touring long distances, but for city and suburban traffic, for quick express delivery and for heavy freight, for the active runabout and the family brougham.

As a spectator, I have been immensely interested in reading of the progress of telegraphy. When I was a boy I heard that among the early experiments was one which required twenty-six wires from one point to another, and at each end of each wire was a pig, and each pig represented a letter in the alphabet. The current sent over a wire made a pig squeal, and the receiver of the message knew that squeal called out the letter of the squealing pig. If that method were still in vogue, imagine what a smell would hover around great cities, and how the price of bacon would be climbing out of sight.

But by and by the progressive spirit worked out the code system, and a message could be sent one way at a time on a metallic circuit. Then some man stumbled onto the fact that if the ends of the wires were stuck into the ground, one would do just as well as two. Then new inventions were added to new inventions, and instead of one message one way on one line at one time, we have a multiplicity of messages each way on the same wire. That was progress in itself—enough for a century, but not enough for us. Marconi and others said, "why all this waste of wires?" "Why all these forests of poles?" and lo! wireless telegraphy was born. Each of us has his own opinion as to the marvels of the time we live in, but, gentlemen, my wonderment is the wireless message. To the uninitiated, it may seem reasonable that we can transmit a sound or a flash over a wire, but to send and receive real messages through unlimited, boundless space, makes a staggering impression upon my very ordinary intellect.

Away back at the time when the telegraph and the Atlantic cable were the most wonderful things in the world, a young man was desperately busy in a noisy machine shop in Boston. He was wholly absorbed in what appeared to be an absurd looking toy. For three years he had been toiling over it, and then on a hot June day in 1875, an almost inaudible sound—a faint twang—came from the machine itself. That twang of a spring was the first tiny cry of the new born telephone, as feeble and helpless as any other baby, and "with no language but a cry." That young man was Alexander Graham Bell, and that baby of his has grown until it is one of the greatest necessities of modern life. When it was patented, there was no name for it in the world's language, and its description called it "an improvement in telegraphy." It is a pretty young child today who would not know that it is nothing of the kind. It is as different from the telegraph as the eloquence of the orator is from the language of a deaf-mute.

The progressive spirit is working: the wireless telegram is with us now; it has become a fact. The wireless telephone is coming, and possibly it will soon be a factor in our every-day life. May be we may yet see the time when every man will be his own "Central," and with a pocket 'phone, he may be able to talk to whom he pleases, at his own sweet will.

In front of the beautiful Union Railway Station in Washington, D. C., there is this inscription:

ELECTRICITY, carrier of Light and Power
Devourer of Time and Space;
Bearer of human speech over land and sea,
Greatest servant of man—itself unknown.

We are told on good authority that there is invested in the electrical business in the United States over $6,000,000,000 and that this large investment has been piled up during the last thirty years. Thirty years ago electric lighting was a marvel; today it is in nearly every home. Every day sees some new application of electricity, which adds to our personal comfort, or the easier and more economic transaction of business.

The progressive spirit is perhaps more marked in lighting than in many of the every day necessities we think are ours by right. Our original human ancestor, as far as history can tell us, was the cave man. As his name indicates, this gentleman lived in a cave—mostly because he did not know what else to do about a home. His activity was much along the same lines as other animals. He arose with the sun, and retired at sunset. He had no desire to sit up late, and was "afraid to go home in the dark." The fact is he had no artificial light at all. He lived on roots and berries, and the raw flesh of some animals. He did not have to hunt for a cook, because he had no fire and no food that needed any preparation. His life was not without its compensations after all. Then one day he accidentally struck a piece of flint, and a spark arrived. From that spark our business started. The cave man was soon staying out at night, and his wife awaited his return with a pine torch to illuminate his cave and some meat stewing in a bronze kettle over a fire. Then bye and bye, grease commenced hanging around that kettle, which would drip into the fire, and somehow the successors of the cave man got the grease hitched onto a rope and the tallow dip was born of a capacity equal to one candle power. It took years to progress, but eventually we got the oil lamp—then artificial gas, and by that time they thought all that was good in lighting had been discovered. The world sat back contented with its illumination until about thirty years ago—and then in a crude form electric lighting was made commercially possible. There have

[1]Address to Electrical League of Southern California, Los Angeles, October 8, 1912.

been issued by the authorities at Washington over 58,000 patents on electrical subjects. We know a large percentage of these must be on lighting matters. It would seem as if the progressive spirit kept at it all the time. The department of commerce and labor is the authority for the statement that the United States uses more electrical energy than any three countries in the world, and is the most brilliantly lighted nation on the face of the earth. Between the Atlantic and the Pacific, and the Gulf and the Great Lakes, there are in use more than fifty million incandescent lamps, and over 800,000 arc lamps. If those fifty odd million of lamps were brought together in one spot, their resplendence would probably equal one of the lesser orbs of the solar system.

Those of us assembled here are engaged in this great electrical business, and speaking for myself, I am glad that during a portion of my career at least I have been given the opportunity to become a part of, and do a little to help along the greatest business in the world. We look back over marvelous discoveries, inventions and applications of electricity during the past 25-years, and we are liable to fold our hands and wear a smile of contentment. The man for whom my company is named, the man who has himself taken out 700 patents on electrical subjects, Thomas A. Edison, has something to mention about that.

To use his words: "we have just started on our electrical way." He considers the chances of big, new, electrical inventions "are much greater than before the telegraph, the telephone, the electric light and the electric motor were invented." He predicts that by 1925 fully fifty billion dollars will be invested in the electrical business, and fully five times as many people will be employed as at present, "most of them in branches for which we have not now even a name." Continuing, he adds "about 100,000,000 carbon filament lamps are made here every year, much the same in all essentials as a quarter of a century ago. We must break new ground. The electrical heating and cooking apparatus are now very ingenious, and better than any other means, but ten years hence they will be superseded and lodged in the museums with bows and arrows and muzzle loader guns."

Perhaps some of you men present get discouraged at times, and think that as so much has been done, there remains so little to accomplish. Well, then, just think again what I have quoted as the works of the electrical wizard, as to what he expects is yet to come.

If I were an electrical engineer, I would be worried all the time because the progressive spirit seems to be crawling along so slowly in the matter of efficiency in generation. Think of it When one of these lights in this room is turned on, the little carbon filament gives barely two per cent of the latent power of the oil burned, or the water force used in the distant power house. Ninety-eight per cent is wasted, dissipated and lost between the oil tank, or intake, and the incandescent lamp. Were every bit of the energy in the oil, or in the head of water, used when you turned on the switch, fifty lamps would have sprung into light instead of one. It is true we now look at the tungsten lamps as a great step forward. So they are, but consider how little of the energy is represented in the oil or water, is given back in the tungstens. One inventor recently speaks of the incandescent and arc lamps as "simply refinements of the torch of the primeval savage, or the common candle, and primitive and inefficient in their present highly developed form." If such is the case, there is plenty of opportunity for the development of the progressive spirit. When we get all that should be gotten of the latent power, we will have wondrous improvements in, and use for light. In all directions we hear the cry "give us more light." Already the carbon filament lamp is beginning to take a rapid movement in the direction of the graveyard, and the a.c. arc is being measured for its coffin. "Give us more light" is the cry in all parts of the laud. Give us the protection which light brings, for before light robbers, cut-throats, incendiaries and assassins must fly. Soon all our country roads will be lined with electric lamps, and as for the cities, they will be as bright at night as the highways on a June evening in the land of the midnight sun. So, Mr. Engineer, you must progress to keep up with the demand, and you must hustle to keep a little ahead of it.

We are not all engineers, however, so let us take a look at the work that is laid out for the others. We who sell the product handled have still a task which needs careful study and constant effort to bring to a satisfactory basis, for others who may succeed us to build upon. We have had drummed into us, daily and hourly, from the moment we entered the business, a lot of talk and stuff about the "peak." Metaphorically speaking, we are wont to stand with our heads back and our faces turned upward, gazing at the marvelous height of the daily or annual peak, and we wonder where it will end. We think it may go out of sight, and that possibly it will get as high as some of the giant trees in the Yosemite Valley, which take two men and a boy to see the top. Gentlemen, I now wish to relieve your anxiety on this subject. This peak bugaboo is coming into its inheritance, and the progressive spirit is already giving it some early payments, square in the back of the neck. That peak business has lorded it over us until at times we were afraid of taking on an extra five kilowatts. Some of us remember a play called the Black Crook. In it there was a scene where the devil made a rapid exit through the floor of the stage. One night in San Francisco, when the play was in full swing, the devil started downward on the trap door but stuck half way. A man in the balcony was much impressed and called out, "Hurrah, Hell's full." One of these days we will take off our hats and shout, "Hurrah, the Peak is dead and the valley's full."

A central station plant ought to be fully loaded 24 hours daily. It does not have to sleep. It is this sleeping that has let that "peak" rule us. There are two elements that will not mix, any more than fire and water, namely load factor and peak. As the load factor goes up the peak diminishes, and I contend that in due course, by the aid of the progressive spirit, a 90 per cent load factor will be a reality.

But we have a lot to do before the load curve becomes a straight line—before the electrical consumption of the community in which we dwell has reached the saturation point. Many records are still to be broken and many reputations to be made if the progressive spirit is encouraged. There are many uses for electricity now, which are not nearly developed. There are many uses coming about which we may only dream of today. The workshops and the factories are eagerly reaching out for the money saving power. How about the farms and the country districts? The stores and office buildings are asking what else we can give them. How about the homes? I know that some of you will say, "Why, look what we have done in that direction?" Well, I'm looking, and what do I see. Electric lighting everywhere, but not enough, and not used for long enough hours. One or two appliances in the average home, just to show how useful they can be. But look at all the drudgery in the home which still may be relieved. Look at the tired women and weary men, who are wearing themselves out because they do not know where to turn for assistance. And all the time we have the servant to do their work, but they don't know it. It is our mission to teach them—to point the way to rest, ease and comfort, and incidetally raise our consumption and bury the peak forever.

NEWS NOTES

INCORPORATIONS.

SEATTLE, WASH.—Western Dry Battery Company, Inc., for $20,000; trustees, James Bennett, Harry E. Bennett and Roy V. Bennett.

PORTLAND, ORE.—Chas. R. McCormick, E. H. Meyers and E. F. McCormick & Company have filed articles of incorporation of the St. Helens Light & Power Company. The company is capitalized at $50,000.

PORTLAND, ORE—Bernard Frohnmayer W. F. Prier and T. J. Geisher and incorparators of the Frohnmayer Water Meter Company,, with a capital stock of $50,000. It is stated that the company will pay special attention to the manufacture and sale of contrivances having to do with the measurement of water.

ILLUMINATION.

BURNS, ORE.—A. Welch of Portland has taken over the electric light plant and has been granted a 25-year franchise.

BREMERTON, WASH.—The council has decided to establish a municipal lighting system and either buy the local plant or put in a competitive system.

LOS ANGELES, CAL.—November 16 has been fixed as the date for the election to determine whether a special lighting district shall be established at El Segundo.

MONTESANO, WASH.—The Northwest Electric & Water Works has made application for permission to build an electric light line from this city to Satsop along the public highway.

SEATTLE, WASH.—The city of Seattle may take over the street lighting contracts for Georgetown as soon as the contracts held by the Puget Sound Traction, Light & Power Company expire.

TACOMA, WASH.—An ordinance was passed authorizing the commissioner of light and water to purchase and install certain electric motors and transformers and appropriating $1700 to pay therefor from the light fund.

LOS ANGELES, CAL.—Plans to light 16¼ miles with ornamental cluster lights, in Van Nuys Lankershim lands in San Fernando Valley are under consideration, $75,000 being appropriated for that purpose. The lighting system will extend from the east line of the boulevard to Encino avenue to Ventura road.

SEATTLE, WASH.—The utilities committee of the city council have recommended for passage an ordinance which will submit to the voters at the March election the question of issuing $425,000 in bonds, the money to be expended in installing an auxiliary plant at the south end of Lake Union to aid the city lighting department.

LONG BEACH, CAL.—The Southern California Edison Company has ordered the installation of a $1,000,000 unit to the plant on the west side of the Long Beach harbor. This unit will have 28,000 h.p. The first two units of the plant will have 36,000 h.p. when the second unit is completed, which will be about December 1. The first and second units will cost about $2,000,000.

LOS ANGELES, CAL.—The Board of Public Utilities and the city council are to be requested by the Pasadena council to fix a base rate of 4 cents a kw.-hr. for electricity to be charged by the Southern California Edison Company to consumers in Los Angeles. The company is permitted under the city's rates ordinance to charge a base rate of 6½ cents. The city council of Pasadena at its last meeting directed that letters be sent to the governing bodies of Los Angeles and all other incorporated cities in Southern California served by the Edison company asking that the several cities reduce rates to a par with those now being charged by the Edison company in Pasadena. The Edison company's rates in Pasadena are lower than anywhere else in Southern California. The only reason that they are so low is because the Edison company for several years has been fighting the municipal electric light plant. Pasadena officials declare the Edison company is charging lower rates than it is entitled to charge in Pasadena, but is making up its losses by charging higher rates than it ought to charge in Los Angeles and eighteen other cities.

TRANSMISSION.

CASHMERE, WASH.—The Northwestern Electric Company proposes to expend $10,000,000 in developing the power of the Klickitat river.

CONCRETE, WASH.—The Pacific Northwest Traction Company of Bellingham, has applied for a franchise to bring their high power wires through here.

LA GRANDE, ORE.—The Eastern Oregon Light & Power Company has purchased the local light plant and is building a transmission line into the town of Elgin.

BREMERTON, WASH.—The Olympic Power Company has awarded the contract to Joe Stangler & Company of this place for constructing a concrete power house on Pacific avenue.

VICTORIA, B. C.—The British Columbia Electric Railway Company will expend $1,500,000 in increasing its power plant at Jordan River. The capacity is 12,000 h.p. and this will be doubled.

KAMLOOPS, B. C.—The date of opening bids for the Barrier river hydroelectric power plant, intake dam and flume system has been extended from noon, November 14, to noon, November 21.

MONTESANO, WASH.—The Northwest Electric & Water Works Company has applied to the board of county commissioners for permission to build an electric light line from this city to Satsop. The matter has been taken under advisement.

SALMON ARM, B. C.—F. Buchanan has been awarded the contract for the installation of line and transmission equipment for the electric light system being installed here. A power house will be built on Front street E. on property recently purchased from Dr. Reinhard.

LOS ANGELES, CAL.—Surveys have been completed and some material delivered for the construction of power transmission lines which will carry energy from the Pacific Light & Power Company, Crane Valley, Cal., to Los Angeles. The lines to run 5 miles east of Bakersfield.

LINDEN, CAL.—The Oro Electric Company has secured a ten acre site on the Witherby place for a power plant and will construct the necessary buildings at once. The representatives of the electric company report that they have secured sufficient contracts already to insure the erection of the plant.

KAMLOOPS, B. C.—Tenders will be received by the city clerk up to November 14 for the construction of the intake dam and flume system of the proposed hydroelectric power plant on the Barriere river DuCane, Dutcher & Company, consulting engineers, suite 911-14 Rogers Building, Vancouver, have the matter in hand Tenders must be addressed to the city clerk, marked "Tender for Dam and Flume." Certified check for 5 per cent of bid required.

OROVILLE, CAL.—The recent rain meant much to the hydroelectric companies, for it increased the flow of mountain streams to a considerable extent, renewed the flow of springs, and deposited moisture in such quantities that the added flow will be maintained for some time. The increase

in the flow of the Feather River, for instance, enabled the Great Western Power Company to take 2000 kw. from its steam plants and add it to the output of the hydroelectric plant at Big Bend.

SAN DIEGO, CAL.—The common council has adopted an ordinance ordering that all wires, cables and other contrivances used for transmission of electricity for light, heat, power and telephones, or any other purpose, be placed underground in conduits 18 inches below the surface. Transformers will be placed in manholes or basement vaults with metal doors. All wires are to be laid snbject to the approval of the inspector of gas and electricity. The ordinance does not apply to wires or poles for street railway.

SAN FRANCISCO, CAL.—That approximately $25,000 will be spent during the winter in the enlarging of the capacity of the Crane Valley reservoir, is the statement made by A. G. Wishon of the San Joaquin Light & Power Company. The walls of the present dam will be increased in height three-quarters of its length which, when filled with the winter flood waters, will increase the capacity of power house No. 1 in this district to four times its present capacity. Emory Wishon was in San Francisco last week in consultation with two engineers. The work will start on the dam in about two weeks and will continue on through the winter months. Nearly 8000 barrels of cement are at present stored in power house No. 1, and there will be little difficulty in securing further supplies in Crane Valley, as the new Big Creek Railroad steams within a few miles of the power house.

TRANSPORTATION.

ALBANY, ORE.—Work has been started on the survey for the new P., E. & E. electric line from Albany to Wells.

ALBANY, ORE.—The Corvallis & Eastern Railway will be electrified between Albany and Corvallis. Work is to be begun shortly.

SALEM, ORE.—An electric line will be built from the Lake Labish district to connect with the Oregon Electric line and the Southern Pacific Railway. Work is to be started in the spring.

SEATTLE, WASH.—Special plans for furnishing 15 semi-convertible electric cars of pre-payment type for the Seattle Municipal Railway were referred to A. L. Walters, superintendent of streets and sewers.

PORTLAND, ORE.—A narrow gauge electric street railway service may be operated on Seventh street, this city. Calvin Heilig and M. C. Dickinson, have applied for a franchise. The matter will be taken up at the next regular meeting of the council

PACIFIC GROVE, CAL.—Sealed bids will be received up to December 2, 1912, for the sale of the franchise, applied for by the Pacific Grove Railway Company, for a franchise to construct and operate a single or double track street railroad in the city of Pacific Grove for a period of 30 years.

LOS ANGELES, CAL.—The city attorney has been instructed to redraft the proposed ordinance granting the Pacific Electric Railway Company a 21-year franchise to carry freight in the industrial district, so that the company shall be granted, instead of a 21-year franchise, a revocable permit

LOS ANGELES, CAL.—The Board of Public Works has issued an order that the Los Angeles Railway Company relay with heavy rails, its line on Temple street from Spring to Belmont avenue, alleging that this street has been torn up three times in the past year to make repairs necessary on account of light rails used. The corporation will be given 150 days in which to complete the work.

RIVERSIDE, CAL.—The Southern Pacific Railroad expects to have electric trains running between Colton and Riverside by February 1, also intends to haul all Salt Lake passenger trains running on Southern Pacific tracks between San Bernardino and Riverside by electric motors. In order to get a franchise to run over the streets in San Bernardino the Southern Pacific had to agree to discontinue the use of steam engines.

VALLEJO, CAL.—Hard Bros., who have the contract for excavating for the Vallejo & Northern Railroad Company in this city, have returned to Vallejo, bringing with them their teams, preparatory to resuming work. With the question of rights of way definitely settled, the road intends pushing operations in Vallejo and Hard Bros. expect to put a large force of men to work at once. Much of the excavating west of Sacramento street has already been done and work will now be expedited east of that thoroughfare across the newly acquired rights of way.

OAKLAND, CAL.—From reports received of progress on the line of the Oakland & Antioch Railway, it is probable that electric cars will be running between Oakland and Antioch by May 1, 1913. Construction work on a subway to permit the Oakland & Antioch trains to pass under the tracks of the Southern Pacific and Santa Fe lines has been started at a point near Avon. A large force of men and teams are doing excavation work at present with the aid of the latest improved type of grading machines. Work is being rushed in order that the subway may be finished within six months, the time specified in the contract. Piledrivers are at work on ferry slips at Chipps Island. It is planned to ferry the cars across the river at this point until the bridge can be constructed.

TELEPHONE AND TELEGRAPH.

PULLMAN, WASH—The Inland Telephone & Telegraph Company has been granted a 50-year franchise in this city.

SLATER, WASH.—A new telephone company is being organized to construct a line between Burbank and Slater. Mr. Stewart is the promoter.

ALTURAS, CAL.—W. J. Bradley and C. S. Ramage have bought the Alturas Telephone Company, including the long distance line between Alturas and Lakeview.

PASADENA, CAL.—What is said to be the first merger of two telephone companies ever forced by a California municipality is effective here, the Pacific and the Home companies being united under the name of the Pasadena Home Telephone Company. After long litigation, which ended in the Supreme Court, the Pacific was forbidden to operate in Pasadena without a franchise. The city then forced the company to pay $32,000 in bank franchise taxes and followed that action by refusing to grant a franchise until the corporation effected a merger with the Home Company. The combination is under the control of the Pacific Telephone Company.

SAN FRANCISCO, CAL.—Final drafts of the proposed ordinance reducing telephone rates in San Francisco have been received by the Telephone Users' Association from the engineers in charge of this matter. Initiative petitions will be immediately prepared by the attorneys for the association, and the ordinance will be submitted for the approval of the people within a short time. If the ordinance is sustained, it will bring into effect the first substantial cut in telephone rates made in San Francisco for many years. The principal reductions will be among the business and professional telephones. The $5 a month phone is cut to $4, with excess switches at 4 cents, a reduction of 20 per cent. The $7.50 phone is cut to $6, and from thence up to the phone which now costs $19.57; the cuts from 20 to 25 per cent. On the private exchanges used by the larger business houses and hotels, little or no change will be made in the flat rate, but the present charge of 2½ cents per switch is cut to 1½ cents, which is the price now charged by the telephone company for switches in excess of 3000 a month. Residence telephones are cut in lesser degree.

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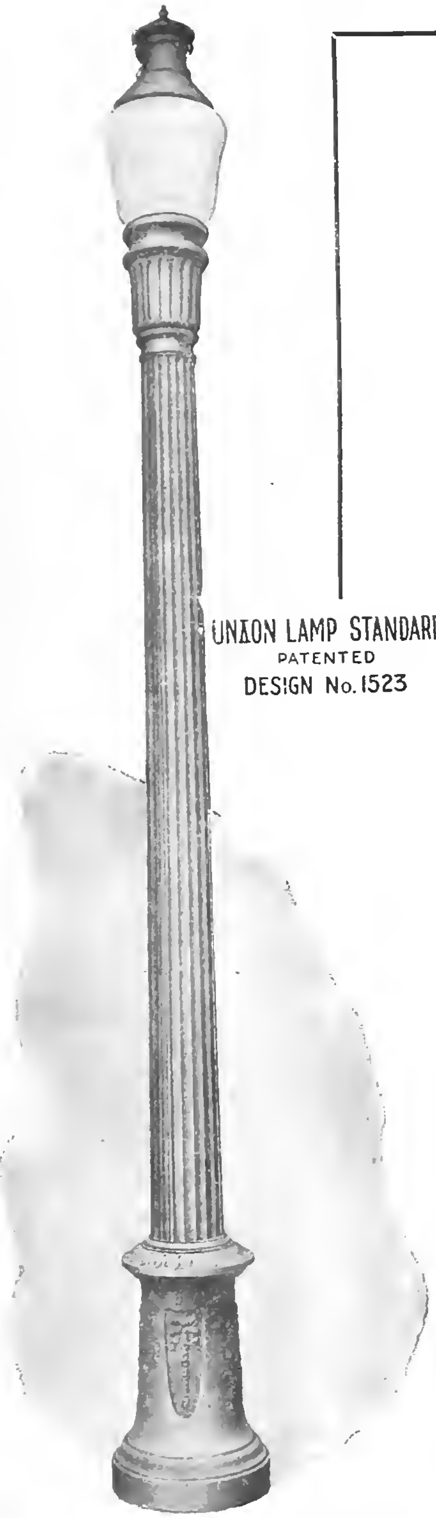

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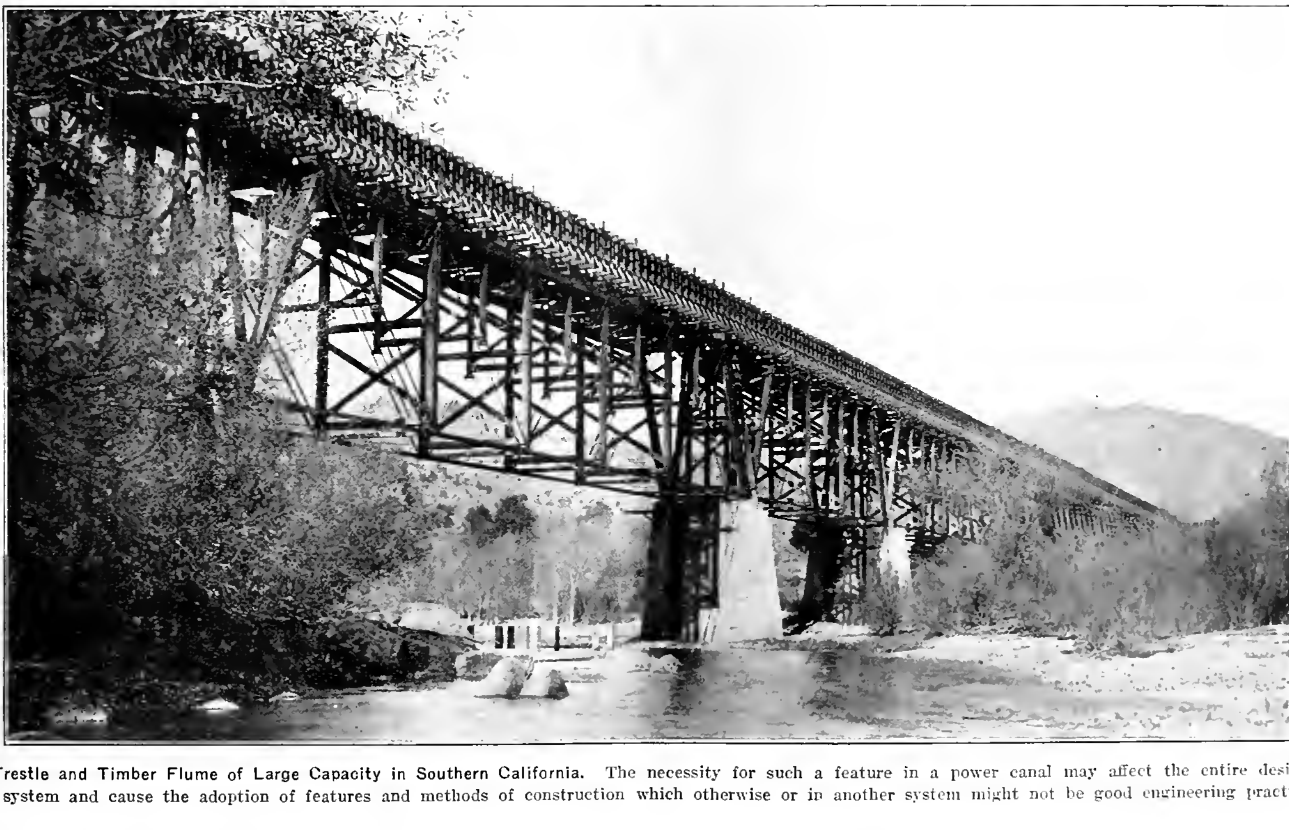
COORDINATION THE KEYNOTE FOR RESULTS

BY RUDOLPH W. VAN NORDEN,
Member A. I. E. E., A. S. C. E.

It is seldom one finds an engineer whose activities have brought him into that vast field of engineering science, the development of power for commercial uses, whether he name his particular class, civil, mechanical, electrical operative or commercial, who does not ride a hobby. Some specific detail in this broad and generally complex division or, better agglomeration of engineering thought appeals for some good reason or other to his sense of the importance of things and his work is known by the completeness and care of this especial part. The rider of another hobby criticises because his has been slighted and perhaps depreciates the value of the stress placed by the first on his work, and so on to the third and fourth.

The fact that each specialist believes and can probably prove beyond any reasonable doubt the importance of his specific branch of the power system, justifies the necessity for the work and care of each one.



A Trestle and Timber Flume of Large Capacity in Southern California. The necessity for such a feature in a power canal may affect the entire design of the system and cause the adoption of features and methods of construction which otherwise or in another system might not be good engineering practice.

But suppose each specialist, without reference to the others, were to so study and design his allotted part, giving his skill and experience an opportunity to play at their best, would the results for which the power system was developed be of a degree which may be justly expected from the combined efforts of these men? The answer is, probably not. This is an hypothetical question to fit, not necessarily a common condition of practice although there are certainly enough examples to justify such a question, but to suggest the necessity of a more thorough understanding; the importance of a more methodical method for correlating the action of these various parts; and for coordination between them that shall finally determine design and application, among the diversified engineers who enter into the work.

In the early day of power development the specialist came into existence as the result of necessity. For instance, the tangential waterwheel evolved to a

Intake to a Power Canal System in Washington. This diversion of great capacity together with a low and inexpensive dam, is a substantial concrete intake and regulating gate, delivering the flow directly into a timber flume, all of excellent design and construction. Complex limiting conditions, commercial, financial, topographical and operative determined the method of design.

high point of perfected design from a practice little better than guesswork. Similar examples could be made of every detail of the system. This specialist, now that he truly is a specialist, is indispensible. Heretofore he has felt that his services need not extend beyond his specific sphere of action, but his very skill has made possible a coordination, which, in order to do justice both to himself and the object of his work, creates the necessity for a broader understanding.

The early power company could be likened to the old country store. It was necessary to go to first principles. All goods were sold by the one clerk and he sold everything. It was the meeting place where everyone's opinion was respected and its simplicity was its salvation. As the business broadened and increased, the various parts of the country store were separated into individual stores which specialized in certain lines, shoes, hats, hardware, groceries and drygoods. This was simple evolution. And then came the third step when these specialists were again united into departments under a single business head and we had the department store. To conduct a department store successfully requires business skill of a rare order; insight into human nature; a thorough understanding of market and trade conditions; and, finally, a coordination which must be a perfect balance. In the realm of this business these points are understood as the essence of success in this line of commercial thought.

Another example: Supposing a great orchestra were brought together with the purpose of giving a series of symphony concerts. The object of this is, of course, the esthetic value, the education, moral uplifting, pleasure, entertainment, or exhibition, as the case may be, of the auditors. A secondary but equally important purpose is a possible pecuniary gain, for if there were not a showing on the credit side of the ledger the failure would be considered sufficient to prohibit a repetition of the venture.

Suppose, in this orchestra, that the musicians had been selected with the utmost care, each being an artist with his instrument, each possessing an instrument of the best make and value. Let is be further supposed that each musician practiced his respective part alone in his studio with his instrument, properly in tune with itself but pitched without reference to those of the other players. Let us further suppose that this orchestra, perfect in the execution of every part should be gathered for the first time to play the opening number of the initial program without having tuned together or having rehearsed together. The horns might drown the strings or the drums give a good imitation of an earthquake. But the audience would hear no symphony and the box office would be hurt worst of all.

The first of these examples is to show by comparison the breadth and importance of power plant engineering, not alone in its details but in the absolute necessity for cooperation and coordination of details to form an operating whole, a successful machine, commercially stated, as everything in engineering is eventually reduced to this basis.

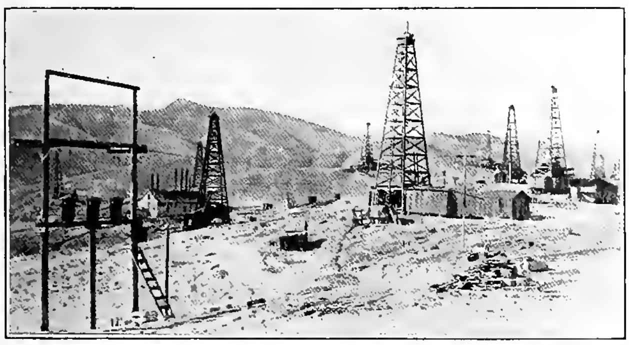
The second example is to better show the absolute necessity for this coordination and to bring out by its very absurdity a similar condition which may readily exist in the general question of power development engineering.

What has been written is an introduction. What is intended is a plea among practicing engineers to a freer and better undertsanding of the subject of coordination in power plant design. And the only method of getting this understanding is by a freer and more comprehensive study of existing works. Not necessarily to follow what was done, but rather to realize the many conditions and combinations of conditions which may present themselves, to profit by the errors or deficiencies which have developed and thereby to enlarge and elevate the general conceptions of power development work. There are probably many who read this, who will say, that every engineer has this very idea. Probably all do in a sense, but it is not carried far enough. Coordination in power plant de-

sign is not held on the high plane which its supreme importance deserves. Any engineer who will take the trouble to make a careful study of existing works will have ample proof of this contention.

A Power Canal in Southern California. This canal has a capacity of about 800 second ft.; it is built on a light grade and is lined with concrete. In many ways this was a daring work.

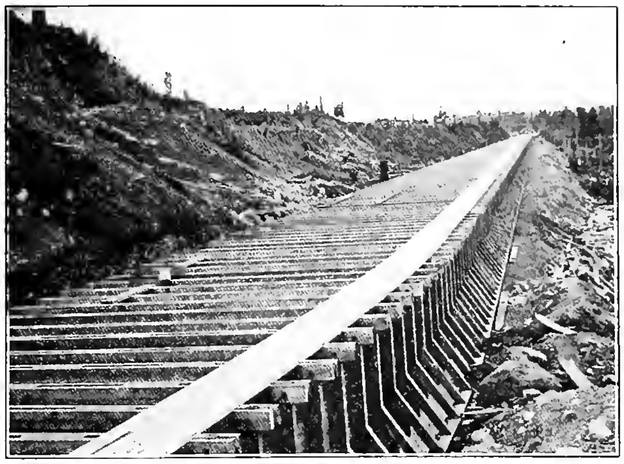
The importance of this subject affects primarily the general power plant engineer. He must in reality understand the method of thought pursued in every branch, electrical, civil, commercial, mechanical and operative. He must depend on the expert specialist. The specialist must then, in order to properly cooperate, make a study of coordination of parts.



Oil Wells Pumped and Drilled by Electric Power. Pumping Water for Irrigation. Widely differing load conditions, in which the power is supplied from the same transmission network. This distributes power in small lots over an enormous territory, and presents for this system a problem in plant design necessitating the utmost economy and yet a perfect service.

Probably the best method of establishing a community of understanding and the placing of this subject on a firmer footing is through the delivery and discussion of papers before our technical societies, the proceedings of which become records of value. It is useless here to enlarge on the efficacy of technical papers in general but only on the value of papers for the subject in hand, describing power plant practice.

There are every year books published on the general subject of power plants. Generally these give a number of examples of what is called practice. In our



A Half Mile Section of the Flume Shown in Fig. 2. This flume has a capacity of about 2,000 second ft. and is probably the largest power flume in existence. Its use at this point undoubtedly represents good practice.

schools and colleges these are used for text books and their influence is undoubtedly widespread. From time to time technical papers are written which are intended to show current practice. Some have been exceedingly interesting and valuable but seldom reach the high plane necessary to treat the subject in its length and breadth. Much can be taught and much learned in a paper so presented as to bring out a discussion on the general subject. In many cases, however, a discussion of this sort will degenerate to an argument on some point of detail which is quite foreign to the subject; points which, it is true, might in themselves be the subject of papers of the greatest value drawing enlightening discussions.

Papers describing new installations or even current practices must necessarily be brief due to lack of space and time on the part of the writer. They should deal not only with the trend of modern practice but with what may be considered as the best thought in the pursuit of this practice together with the reasoning. If this is not possible, then descriptive papers will be technically of no greater value and by no means as complete as the descriptions of hundreds of plants to be found in the columns of technical journals. Specialties and oddities in design of certain parts, due to unusual conditions are valuable only when these conditions are explained and this should be thorough enough to give a clear insight into the method of reasoning or to excite a discussion which shall bring it out.

What may be acceptable practice and good engineering in one place may be the utmost folly in another so that no fixed rules can be drawn. The

problem is always one for the engineer and the correctness of his reasoning is the rule for the economic result.

This may be illustrated in the design for a pressure pipe system for an hydroelectric plant. The design of a pipe for strength and carrying capacity is a simple matter, but the design of the layout for a specific set of service, financial or topographical conditions is quite different and may be a matter of much complexity. In the same manner, the mere statement that there are certain classes of dams and water conduits and that one type was used at one place and another type at another is most misleading and of little value. Where the use of these is an obvious necessity little can be said, but where their adoption is due to a proper coordination with all other factors is what should be brought to light.

The whole engineering profession is looking for papers that would describe perhaps only one installation but would give the why and wherefor of the design of each part, and not a mere statement of a few examples which stand together in their corelation like so many words in a dictionary. Our technical books and records are full of treatises on the design of details and we can never tire of any new development to be described, illustrated or worked out in any way. But let us put the great subject, which our Western engineers should be the most capable of understanding, that of power plant design, or power plant practice, or whatever else one may wish to call it, on the plane which it deserves. Let us have papers which will treat that subject in perspective, and then go to the details with the proper logic of their adoption. We have all learned a very little of these things. There is much more to be learned and a better and closer understanding held between every engineer interested in this work will do more to establish correct practice than anything else that can be suggested.

OREGON'S NEW PUBLIC UTILITY COMMISSION.

The Railroad Commission of Oregon has just been given jurisdiction over all public utilities in that state by a new law which was passed at the regular election on November 5, which extended the authority of the commission from railroads alone to all utilities. The bill was carried by a majority of about six thousand. Because of the fact that the bill will go into effect immediately, and in order that they may be able to take up the additional duties now placed in their hands, as soon as possible, the present members of the railroad commission will proceed at once to familiarize themselves with the new work.

The main features of this bill are taken from the Wisconsin Public Utilities Act as it was first passed by the Oregon legislature at its regular session in the spring of 1911. Certain representatives and state senators from Portland contended that the most desirable features of the Wisconsin law were not included in the one passed by the Oregon legislature, but aside from this there was very little other opposition and the objections were overcome and the bill was passed and declared a law. Certain persons in Portland, interested in "Home Rule" regulation, stirred up agitation shortly afterward and considerable opposition was then manifested in Portland against the new law. The same people brought up by the initiative petition a bill for a local public service commission for the City of Portland and the election on this bill was set on the regular municipal election in June, 1911. At the same time a popular referendum was invoked upon the state wide commission bill and this referendum was designed for the purpose of postponing the date that the state wide bill should become effective and of bringing it up to the people for approval or disapproval at the regular city election in November, 1912. In June, 1911, the Portland utility commission bill was defeated by a very small vote and the city was left entirely without regulation for over a year and a half.

In the fall of 1912, the same persons who endeavored to secure the passage for the Portland public service commission bill in 1911, prepared new petitions and had a similar bill put on the ballot at the city election on November 3, but this bill was defeated by an overwhelming vote for the reason that it was generally conceded that the state wide bill would pass on November 5, and the voters of Portland did not believe very strongly in a municipal public service commission.

The railroad commission of Oregon is now vested with the power and jurisdiction of supervising and regulating all public utilities in the state of Oregon. The new bill requires adequate service and reasonable rates, common using of certain facilities and compensation therefor, valuation of properties, uniform accounting and reports. All rates, tolls and charges shown on schedules of tariffs, which are filed with the commission, shall not exceed the rates, tolls and charges in force on January 1, 1911. The commission, in addition to its other powers, is also given the powers for investigations, hearings, etc., similar to those given other state commissions, and appeals can be made to the various state circuit courts and from there to the supreme court of the state. The commission is also vested with the authority to investigate accidents. The present members of the railroad commission which has been in existence for several years, are C. B. Aitchison, chairman; Thomas K. Campbell and Frank J. Miller, and its offices are at Salem, Oregon. Owing to the increased business which will naturally come from the extension of its jurisdiction, it will be compelled to provide additional office force.

THE COKING OF COAL AT LOW TEMPERATURES.

"The Coking of Coal at Low Temperatures, With a Preliminary Study of the By-Products," by S. W. Parr and H. L. Olin has just been issued as Bulletin No. 60 of the Engineering Experiment Station of the University of Illinois. This bulletin reports the results of experiments on various types of Illinois coal with reference to the principles which govern their use in the production of coke. The temperatures used did not exceed approximately 750 degrees F. Reference is also made to the by-products obtained at the temperatures employed. Copies of Bulletin No. 60 may be obtained upon application to W. F. M. Goss, Director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

SCIENTIFIC PLANT MANAGEMENT

FIFTEEN FUNDAMENTALS IN EVAPORATIVE BOILER TESTS.

BY J. P. ZIPF.

By far the majority of boiler tests are made to determine the evaporative ability of a boiler. These tests may be incidental in determining more special characteristics—the fulfillment of a guarantee clause in a contract, the comparison of various types of burners or the effect of the rearrangement of baffles, furnace or other constructive features of a boiler. Before a test is made its purpose should be known. When testing for maximum efficiency it is advisable to make some preliminary runs, in order that the boiler may be in efficient working condition.

In order that the data taken during the test may not be indefinite, gauges, weighing scales, and thermometers should be calibrated before use, and recalibrated after the test for verifying the supposition that their error has remained constant during the test.

The piping should be so arranged that by a combination of valves and by-passes all the water and all the oil used during the test is conveyed to the weighing tanks. At the conclusion of the trial the boiler may be placed back in the line without any interruption in service. Means should be provided to definitely prove that neither water nor oil is supplied to the boiler unless accounted for. Thus, any leaks between the weighing tanks and the boiler should be accounted for and deducted from the weight of water (or oil) recorded as having been fed to the boiler. Separate feed pumps and supply tanks for oil and water should be provided, the plant auxiliaries being used to supply water and oil to the weighing tanks.

At the beginning of a test, the level of the water in the gauge glass is noted and an endeavor should be made to keep this level constant, especially so at the end of regular intervals, usually one hour. At the end of each hour during the test the water level in the supply tank is brought even with the mark at which it was at the time of starting the test; this is best indicated by the point of a hook gauge. This leveling will accurately mark the water weighed during the hour.

The weighed oil in the tank supplying the oil pump is brought to the point of a hook gauge at the time of starting and at the end of every ten or fifteen minute interval during the test. The consumption of oil and feed water for regular intervals determines in a great measure the uniformity of operation of the boiler, this being especially true for the oil consumption. In addition to the oil and water weights the following items are observed and recorded at intervals of ten or fifteen minutes:

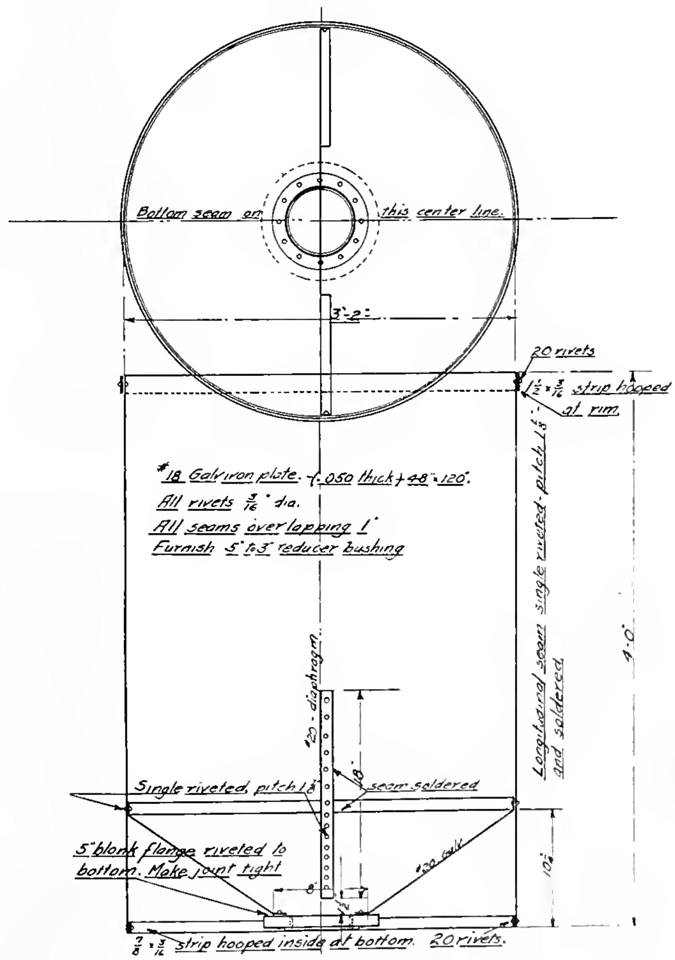
1. The saturated steam pressure is read on a gauge, usually the most prominent gauge on the boiler. Steam gauges are adjusted to read zero at atmospheric pressure.

2. The superheated steam pressure is read on a steam gauge if the boiler supplies superheated steam. If saturated steam is supplied, the quality of the steam must be obtained with a steam calorimeter of which there are two types in general use. The separating calorimeter, in which the moisture in a sample of steam is separated mechanically, and measured, or the throttling calorimeter, in which the quantity of moisture is obtained indirectly by observing the heating effect of the steam after it has expanded to atmospheric pressure.

3. The superheated steam temperature is observed on a mercury thermometer of high range. The thermometer is immersed in a thermometer well located in the steam main as near the boiler as possible; it should even be placed ahead of the boiler stop valve. If the thermometer stem is graduated for total immersion, and a considerable portion of it emerges from thermometer well the temperature as read may be too low by even as much as 12 degrees F. The correction for an emergent stem was given in this Journal March 30, 1912, page 285.

4. The temperature of the fire room and external air are taken for use in heat balance calculations.

5. The temperature of the feed water is taken at a thermometer well located in the feed pipe close to its entry into the boiler.



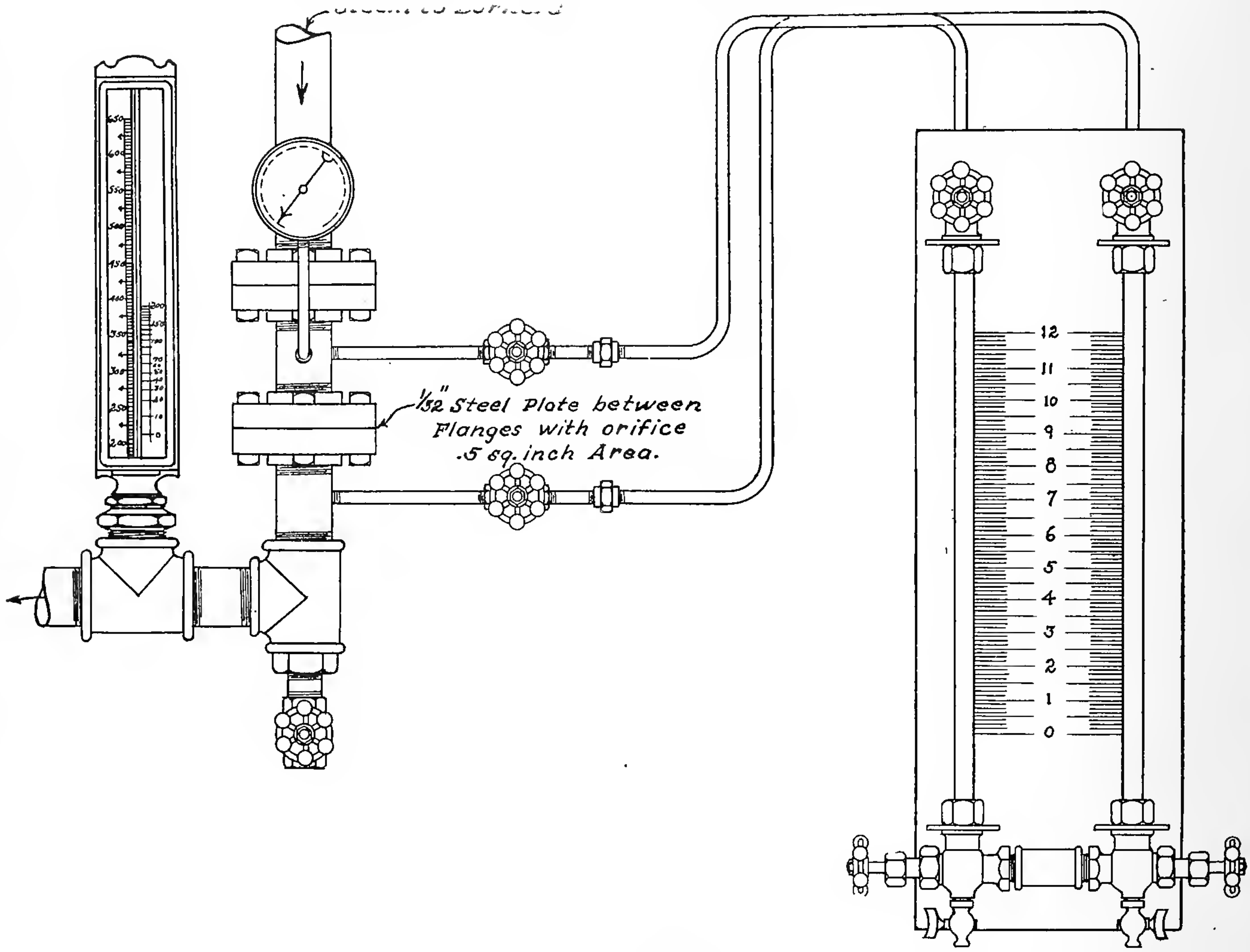
An Excellent Design for Weighing Tank in an Evaporative Test.

6. The temperature of the escaping gases is taken at a point in the breeching, preferably before the damper. The correct location of the pyrometer is important; it should be well in the path of the gases away from the influence of bends, and the cooler layer of gases near to the breeching. A mercury thermometer of high range can be used, but a thermo-electric pyrometer is most convenient and quite accurate. Temperatures are some times taken at the various "passes" and in the furnace. For the latter temperatures a radiation pyrometer is almost essential.

7. Draft pressures at various points along the path of the flue gases are taken on a draft gauge. One gauge can be fitted with a manifold arrangement of pet-cocks to get observations at several points, the connections being made with good rubber tubing and a 1/8 inch iron pipe inserted through holes in the boiler setting, well into the flue gases. Draft is expressed in "inches of water," and while water may not be used as an indicator, the scale is so graduated that the reading is "inches of water" when the particular liquid is used for which the gauge is designed.

8. The oil pressure on the burner is maintained uniform to insure uniform firing. The temperature of the oil is taken before its entry into the burner.

9. The steam supplied to atomize the oil is usually determined indirectly on a mercury manometer or U-tube. The two legs of the U-tube connect to either side of an orifice in a thin plate located in the steam line to the burner. The differences in pressure on the two sides of the orifice, with steam flowing, is shown by the position of the ends of the mercury column against a suitable scale. The column should be calibrated in place. This calibration is accomplished by condensing in a barrel of water the steam passing through the orifice in a given period of time. The weight of steam condensed will be the difference in weight of the barrel of water before and after the run. The data is then plotted, thereby forming a calibration curve.



An Improved Method of Determining Quantity of Steam Used in Atomization.

10. For the comparison of burners the steam and oil pressures within the burner are recorded.

11. The barometric pressure is necessary to convert gauge pressures into absolute pressures.

12. The flue gas is analyzed during the progress of the test for an indication of the furnace conditions. The ordinary "Orsat" apparatus admits of analyzing the flue gas for carbon dioxide (CO_2), free oxygen (O_2) and carbon monoxide (CO), in percentage by volume of dry flue gas.

13. A steam flow meter, read every half minute, or minute, is a good indicator of the uniform operation of the boiler.

14. A log sheet should be kept by the person in charge of the test, and a record made of every item concerned with the operation of the boiler. The log sheet should include the date, time of starting and stopping the test, such boiler dimensions as are necessary, the condition of the fires, tubes, dampers, ashpit doors, load fluctuations on the plant as a whole, etc.

15. An average sample of the fuel oil is obtained in a clean container—preferably a can with a screw top—for determinations of the gravity of the oil, its moisture content and calorific value. The container should be filled only two-thirds or three-quarters for convenience in the later laboratory manipulation.

When an efficiency test is contemplated the boiler should be overhauled if necessary, and the brickwork made tight. It should be fired at about rated load for some hours before the test is actually begun in order that the brickwork should be at an even temperature. The soot should be blown from the tubes just before putting the boiler on the steam line.

Data should be taken commencing about half an hour before the test is recorded as having been begun, as there are always minor adjustments to make in the draft, oil consumption, and condition of the fires. The water and oil weights should be started and stopped with precision. The other data should be taken at regular intervals, the assistants on the test observing a routine in reading their instruments. For instance, the one who reads pressures should start at the beginning of the time interval at a certain gauge and repeat this cycle in the same order throughout the test. The weighers should be careful in reading the scales and recording the weights correctly. On important tests an assistant should have nothing to do other than check the weights and calculations independently of the weighers.

RATE FIXING AND APPRAISAL

Practical Illustration in the Determination of Gas Rates.

BY C. L. CORY.

In order to illustrate definitely some of the factors that should be given consideration in the determination of the rates for gas service, I have compiled some data and figures upon a gas plant and system which I will say frankly has no physical existence so far as I know. In other words, while the figures are, I am sure, quite representative of many small gas plants and systems on the Pacific Coast, yet the figures given do not apply exactly to any particular installation..

I can assure you, however, that in general the men who have had experience with such gas service installations may be like the old farmer who was with wonderment and awe seeing a circus for the first time in his life. In the menagerie tent he caught sight of a dromedary. He looked at it a long, long time and finally observed with great positiveness, "There ain't no such animal." And so I will not be surprised if many of you decide in your own minds that "There ain't no such gas company" as the one I have created for the purposes of illustration.

I can assure you, however, that in general the data corresponds to the average small isolated gas plant and system manufacturing its own gas and with the consideration of some of these figures, we may be led to some important conclusions necessarily involved in the equitable determination of reasonable gas rates.

The following data include the important facts pertaining to the gas plant and system used for the purposes of illustration:

Population served	12,000
Cost of oil, per barrel	$0.80
Cost of oil, per year	$14,300
Installed capacity of gas plant, per day	410,000 cu ft.
Installed capacity of gas plant per year	150,000,000 cu. ft.
Total gas manufactured, as measured by station meter, per year	71,000,000 cu. ft.
Cost of oil per 1000 cu. ft., gas manufactured	$0.205
Gallons of oil used per 1000 cu.ft. of gas manufactured	10.65 gals.
Total gas delivered to customers' meters or sold, per year	60,000,000 cu. ft.
Cost of oil per 1000 cu. ft. of gas sold	$0.238
Difference between quantity of gas manufactured and sold	11,000,000 cu. ft.
Per cent difference between gas manufactured and gas sold	15.5%
Aggregate length of distribution sytesm or mains in miles	37.5
Average cost-distribution system or mains per mile, exclusive of services, meters, etc	$3,335
Number of customers	2,800
Number of customers per mile of mains	75
Total valuation of system	$362,500

In the consideration of the economics of electric light and power installations and service, it is quite usual to determine the investment or value of the plant per unit of capacity or per unit of output. While this is done less often in the gas business, it is interesting to contrast the unit investment required in a gas manufacturing plant and system based on the installed capacity, the quantity of gas manufactured and delivered to the holders and the amount of gas delivered to customers' meters.

TABLE I.

Investment in gas manufacturing plant including holders, distribution system and services, meters, etc., per installed capacity—per 1000 cubic feet of gas manufactured, and per 1000 cubic feet of gas sold.

		Investment per 1000 Cu. Ft.		
Portion of System—	Investm't.	Installed Capacity	Gas M'f'd.	Gas Sold
Gas Manufacturing Plant	$195,000	$1.30	$2.75	$3.25
Distribution System	125,000	.83	1.76	2.09
Services, Meters, etc	42,500	.28	.60	.17
Total	$362,500	$2.41	$5.11	$6.05

Table I gives this information for the plant under consideration which it is assumed has a total value including the physical plant and also the value of the company as a going concern, amounting in the aggregate to $362,500. This total is subdivided as indicated, the gas manufacturing plant representing $195,000; the distribution system exclusive of customers' services $125,000, and finally customers' services, meters, etc., being $42,500.

In this installation the investment per thousand cubic feet of the plant capacity is $2.41, while the corresponding investment per thousand cubic feet

manufactured is $5.11, and per thousand cubic feet of gas sold, $6.05.

I have used the word investment in the above statement as synonymous with, and the same as, value, which includes not only the physical plant, or possibly the cost of reproduction new but also the going value due to the established business of the company.

Table II sets forth in detail the total annual generating costs and the cost of manufacturing per thousand cubic feet of gas sold. The different items, which are

TABLE II.

Annual Generating Costs and Cost of Generation per 1000 Cubic Feet of Gas Sold.

Item—	Per Cent	Yearly Total	Per 1000 Cu. Ft.
Return on investment	8 per cent	$15,600	$0.260
Taxes	Based upon gross receipts	1,245	.021
Depreciation	Av. on depreciable portion—5 per ct.	5,350	.089
Oil		14,300	.238
Station wages, maintenance, operation and station supplies		10,150	.169
Total		$46,645	$0.778

included in the total annual operating costs of $46,645, include the rate of return of 8 per cent upon the investment or total value of the plant, the taxes based upon 4 per cent of the gross receipts in accordance with the California tax law, depreciation only on the depreciable part of the manufacturing plant, not including real estate for instance, the necessary fuel oil and finally station wages, maintenance, operation and station supplies.

Table III gives the corresponding figures for the total annual cost of distribution as well as the cost of distribution per thousand cubic feet of gas sold and delivered to customers.

TABLE III.

Annual distribution (not including services, meters, etc.), charges and cost per 1000 cubic feet of gas sold, and delivered to customers.

Item—	Per Cent	Yearly Total	Per 1000 Cu. Ft.
Return on investment	8 per cent	$10,000	$0.167
Taxes	Based upon gross receipts	800	.013
Depreciation	Av. on depreciable portion—3 per ct.	3,250	.054
Maintenance and operation		5,900	.098
Total		$19,950	$0.332

Table IV contains similar items entering into the total annual cost of serving, metering, billing, and collecting, which naturally include office expenses, as

TABLE IV.

Annual service, metering, billing and collecting, etc., charges and cost per 1000 cubic feet of gas sold to customers.

Item—	Per Cent	Yearly Total	Per 1000 Cu. Ft.
Return on investment	8 per cent	$ 3,400	$0.057
Taxes	Based upon gross receipts	400	.007
Depreciation	Av. on depreciable portion—4 per ct.	1,750	.029
Salaries, wages, office expense, etc.		12,000	.200
Total		$17,550	$0.293

well as the cost of these items per thousand cubic feet of gas sold.

Table V is a summary of Tables II, III and IV, and while there are many valuable points to discuss

TABLE V.

Total Cost of Gas Services per 1000 Cubic Feet of Gas Sold, and Delivered to Customers.

Item—	Yearly Total	Per 1000 Cu. Ft.
Generation	$46,645	$0.778
Distribution	19,950	.332
Service, Metering, etc.	17,550	.293
Total	$84,145	$1.403

in each of these three tables, I will only refer to the summary as indicated in Table V.

The total operating expenses added to the amount necessary to provide a return upon the value of the plant at 8 per cent per annum is $84,145 per year. If not more than 60,000,000 cubic feet of gas can be sold in the district, the necessary average price per thousand cubic feet of gas sold is practically $1.40.

Do not let it be understood, however, that it is proper to conclude that $1.40 per thousand cubic feet is the proper rate, since it may be not only possible but extremely desirable both for the benefit of the company as well as its customers to increase the total gas sales, let us say, about 40 per cent, which would make the total annual amount of gas delivered to customers 84,000,000 cubic feet. If this increased consumption could be attained without materially increasing the investment required, gas could be sold at an average rate of $1.00 per thousand cubic feet resulting in a total annual revenue of $84,000 which is adequate to give the revenue required to provide a proper return upon the value of the plant.

The important point, gentlemen, is this: What principle should be our guide in the establishment of a gas rate? Attempt to maintain a rate as high as $1.40 per thousand cubic feet, probably thereby reducing the total annual aggregate sales, or make every consistent, reasonable, yes, even possible effort, within the limits of good business policy to increase the sales of gas to as much as 84,000,000 cubic feet per year and adopt a dollar rate per thousand cubic feet. You, gentlemen, are much more capable than any one else in giving the proper answer to this most vital question.

(To be continued)

AUTOMOBILE HORSEPOWER DETERMINATION.

A parliamentary committee recently appointed in England to consider amendments to the present method of determining the horsepower of automobiles for taxation purposes has reported and recommends few changes. The committee considered that the proper basis for rating should be the average power which the engine of a car could develop in regular use on the roads if there were no restrictions in speed other than those imposed by the car itself.

In gasoline and steam cars the present method for determining the horsepower is to divide the piston area in square inches by 2½ for engines of single-acting cylinders with a single piston, by 1 3-5 for single-acting cylinders having two pistons; and by 1¼ for double-acting cylinders having a single piston. It was recommended that this formula be left unchanged for gasoline cars. For steam cars, however, it was considered that the rating should be determined on the basis of the effective heating surface of the boiler rather than the dimensions of the engine, and that this heating surface should be taken to be the whole of the surface in the case of horizontal tubes and half the surface in the case of vertical tubes. The proposed rate is 1 horsepower for every 3 sq. ft.

For electric cars the present regulations prescribe that all motors shall be considered as developing 12 to 15 horsepower, and the committee recommends that this be lowered to 6½ to 12 horsepower.

ELECTRICAL PUMPING AND IRRIGATION

FLOW OF WATER IN CANALS.

BY B. A. ETCHEVERRY.

The coefficient C_1 in Chezy's formula as already developed in this series depends on form of cross section, on roughness of channel and very slightly on the grade. The formula most generally used to obtain this coefficient is Kutter's formula:

$$c_1 = \frac{\frac{1.811}{n} + 41.65 + \frac{.00281}{s}}{1 + \frac{n}{\sqrt{r}}\left(41.65 + \frac{.00281}{s}\right)}$$

n is the coefficient of roughness. The values of this coefficient as determined by experiments by Canguillet and Kutter, by Fortier and by others, are:

$n = .010$ for a lining of pure cement plaster, planed timber, glazed surface in perfect order.

$n = .012$ for wooden pipe, unplaned timber in good order, clean iron and steel surfaces, smooth plaster of sand and cement, concrete lining applied with metal forms.

$n = .014$ for brickwork, well dressed stone work, iron, ordinary concrete lining applied with dressed lumber.

$n = .016$ for riveted steel pipe.

$n = .0175$ for canals in earth in excellent condition, well coated with sediment, regular in cross section and free from vegetation, loose pebbles and cobble rock.

$n = .020$ for canals in earth in good condition lined with well-packed gravel partly covered with sediment with an occasional patch of low water plants, or composed of loose gravel without vegetation.

$n = .0225$ for canals in earth, in fair condition, the wetted surface being lined with sediment, with an occasional patch of minute algae, or composed of loose gravel without vegetation.

$n = .0250$ for canals in earth in average condition having few sharp bends and being fairly uniform in cross-section; the water slopes and bottom being lined with sediment and low water plants, or composed of loose gravel and fragments of rock less than two inches in diameter and free from vegetation.

$n = .0275$ for canals in earth below the average in grade, alignment and cross-section; having indentations on the sides, the edges in places partially filled with earth and gravel and the lining composed of coarse gravel and cobble rock unpacked. This value would also apply to a smooth regular surface if the channel were partially filled with aquatic plants or to a ditch in solid rock excavation with rough faces.

$n = .0300$ for canals in earth in rather bad condition having the bed partially covered with debris; or having comparatively smooth sides and bottom with bunches of grass and weeds projecting into the water or more or less aquatic plants growing in the channel.

$n = .040$ for canals in earth whose channels are about half full of aquatic vegetation.

$n = .050$ for canals in earth whose channels are about two-thirds full of aquatic vegetation.

A new formula for the velocity of water has been derived by Clarence T. Johnston from a series of investigations conducted by him while State Engineer of Wyoming. From these investigations he found that the value of "n" depended on not only the character of the material, but also on the value of "r" (the hydraulic radius) decreasing with an increase in r. To allow for this he deduced an exponential equation of the form $v = Cr^ps^q$. From his experiments he has found that the value of q was 0.5 and for C and p he obtained the following values:

Table of the values of exponents in the formula for the velocity of flow in ditches and canals.

	C	p
Clean straight ditch in earth or firm gravel, free from vegetable growth, made smooth by use..	59.8	0.76
New ditch in earth, with straight channel	45.5	0.80
Old ditch in earth, with straight channel	42.8	0.83
Old ditch in earth, with crooked channel and some vegetable growth	35.0	0.85
Solid rock excavation, crooked channel, rough face	48.5	0.80
Solid rock excavation, straight channel, rough face	50.5	0.83
New ditch in loose rock, with crooked channel.	41.5	0.80
New ditch in loose rock, with straight channel..	41.5	0.83
Old ditch in loose rock, with crooked channel and some vegetable growth	33.0	0.85

Factors affecting flow in canals.

Chezy's Formula and Kutter's Coefficient Formula, and also Johnston's formula show that the velocity depends on coefficient of roughness, hydraulic radius or form of cross section and slope or grade. For approximate consideration of the effects of these factors on the velocity, the following relation is almost exactly correct: First—The velocity varies with the square root of the grade. For instance, increasing the grade four times (other conditions remaining the same) will double the velocity. Second—The velocity varies inversely with the value of the coefficient of roughness, so that an error in selecting the correct value of this coefficient will produce an error of the same proportionate amount, but in the opposite direction; for instance, if the velocity corresponding to n = .025 is 2 ft. per second, the velocity for n = .020 will be 2.50 ft. per second. To facilitate the solution of problems, in which these formulas enter, diagrams are used which eliminate the lengthy computations.

Relation between factors.

In irrigation problems the required carrying capacity is known; it is determined from the duty and from area irrigated. The other factor which is also generally known is either the grade or the velocity. The factor "n" must be selected according to material. The following cases generally arise:

1st Case: Known, the required capacity and the grade; find the suitable velocity. In the form of cross section (proportion of bed width to depth and side slopes) is fixed, then the velocity can be found by Kutter's formula or diagrams and this determines the area of the cross section. If the form of the cross section is not fixed, then the velocity can vary between limits, but for every velocity there is a fixed form of cross section. The maximum velocity is obtained with the section offering the least wetted perimeter or greatest hydraulic radius. The range of velocities is usually small.

2d Case: Known, the required capacity and the desired velocity; find the grade. Before the grade can be found the form of cross section must be fixed. The section having the greatest hydraulic radius will require the flattest grade. The range of grades is usually small.

Velocities of canal.

The velocity of water in canal must not exceed a certain value or maximum velocity beyond which it would erode the beds and endanger bridges, drops and other works. The velocity must be large enough to prevent the growth of plants and also to prevent the deposition of silt in the canals. The velocity in the main canal must not be larger but preferably smaller than the velocity in the laterals so that the silt will not be deposited before reaching the irrigable lands. In America a velocity of 2 to 3½ ft. is required to prevent the growth of weeds. It is better to give too great than too small a velocity, as in the former case measures can be adopted to protect the channel or falls can be introduced. In the latter case the deposition of silt may be serious and necessitate annual clearance at great expense.

The maximum velocity depends on the erosive power which is the power of overcoming cohesion which varies mainly with the texture of the soil and the size of particles. The erosive power of water varies as the square of the velocity. Safe values are given in the following table. The bottom velocity is assumed to be equal to 75 per cent of the mean velocity.

Table showing safe average and bottom velocities.

	V_a (Av. vel.)	V_b (bottom) = $.75V_a$
In very fine sandy soil or loose silt	.50	.375
In pure sand	1.00	.75
Light sandy soil, 15% clay	1.20	.9
Light sandy loam, 40% clay	1.80—2.00	1.325—1.5
In coarse sand	1.5 —2.0	1.12 —1.5
Loose gravelly soil	2.50	1.875
Ordinary loam	2.50	1.875
Ordinary firm soil or loam, 65% clay	3.00	2.25
Stiff clay loam	4.00	3.00
Firm gravelly clay soil	5.00—7.00	3.75 —5.25
In stiff clay	6.00	4.50
In conglomerates, soft slate	6.50	4.875
In stratified rocks	8.00	6.00
In small boulders	8.00—15.00	6.00—11.25
Hard rock	13.33	10.00
Concrete	15.00—20.00	11.25—15

The values given for concrete are safe for water carrying small amounts of silt or fine sand; where the water carries coarse sand, the bottom velocity should probably not exceed 8 ft. per second, while for clear water there is practically no definite limit for the maximum velocity. A. P. Davis, Chief Engineer of the U. S. Reclamation Service, in a paper on Safe Velocities of Water on Concrete) Engineering News, Jan. 4, 1912) mentions the following illustrations of high velocities safely resisted by concrete: First—A velocity of 40 ft. per second and more for a spillway chute on the Strawberry Valley project, Utah. Second—A velocity in excess of 20 ft. per second on the South Canal in Uncompahgree Valley, Colorado. Third—Velocities estimated at 75 to 90 ft. for a period of six months, in a culvert through the Pathfinder reservoir. The beds of rivers protected by aquatic plants, however, bear higher velocities than this table would assign, up to 2 ft. per second.

The minimum velocity is dependent on transporting power. From a large number of experiments it has been found that the diameter of bodies which can be moved by the pressure of a current varies as the square of the velocity or that the weight varies as the sixth power of the velocity. This law is only good with stones of the same shape and is only approximately correct. The minimum velocity to prevent the deposition of silt has been variously estimated at from ½ foot per second to two feet or more per second. For waters carrying fine silt the minimum velocity should probably be not less than 1 foot per second and for waters carrying sand not less than 2 feet per second, and preferably mean velocities of 2.5 to 3.5 feet per second should be used. The deposition of silt is more liable to occur where there is a sudden change in velocity. R. G. Kennedy, after many experiments made on irrigation canals in India, found that to prevent silting the mean velocity and the depth of water were related and that the mean velocity should not be less than that obtained by the following equation: $v = 0.84\, d^{.64}$. The equation refers to silt or sand in suspension and not to the coarser sand which is rolled along the bed of the canal and which is more often the cause of the most trouble. Merriman gives the following values for the velocities required to move different materials:

	Bottom velocity.	Mean velocity.
For Clay	0.25 feet per sec.	0.33 feet per sec.
Loam or earth	0.50 " " "	0.67 " " "
Sand	1.00 " " "	1.33 " " "
Gravel	2.00 " " "	2.67 " " "
Pebbles, 1 inch in size.	3.00 " " "	4.00 " " "
Spalls and stones	4.00 " " "	5.33 " " "
Large stones	6.00 " " "	8.00 " " "

Canal cross section having most advantageous hydraulic elements.

1st. General case, applicable to all side slopes.

The problem of finding the form of cross section which will have the greatest carrying capacity for a given cross sectional area and for a given side slope is

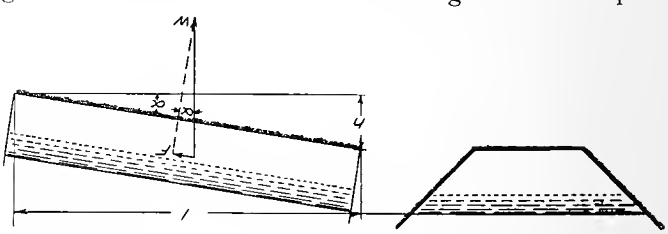
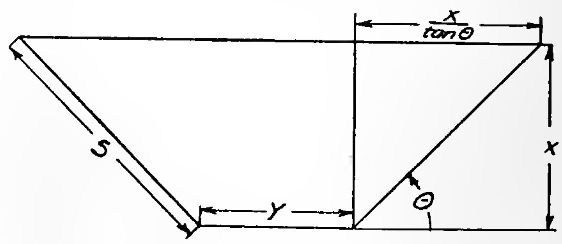


Illustration of Typical Constants Used in Canal Design.

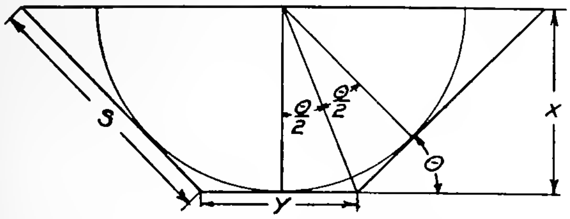


The Trapezoidal Canal Section.

the same as finding the cross section which has the smallest wetted perimeter. The problem may be solved by first obtaining an equation for the perimeter (p) in terms of the area (A), the side slope angle (θ) and the depth of water (x); and then take the first derivative of the equation for p and find the value x, then of y, which give the minumum value of p.

$$x = \sqrt{\frac{A \sin\theta}{2 - \cos\theta}} \ . \ y = 2x \tan\frac{\theta}{2}$$

The following graphical method however will be found more convenient to determine the proportions



Standard Notation for Trapezoidal Canal.

of the cross section having the most advantageous hydraulic elements. Describe a circle having its center in the water surface; draw the sides of the desired slope and tangent to the semi-circle, and draw the bottom tangent to the lower point of the point of the circle . The section thus obtained gives the same relation between y and x as expressed in the equation $y = 2x \tan \theta/2$.

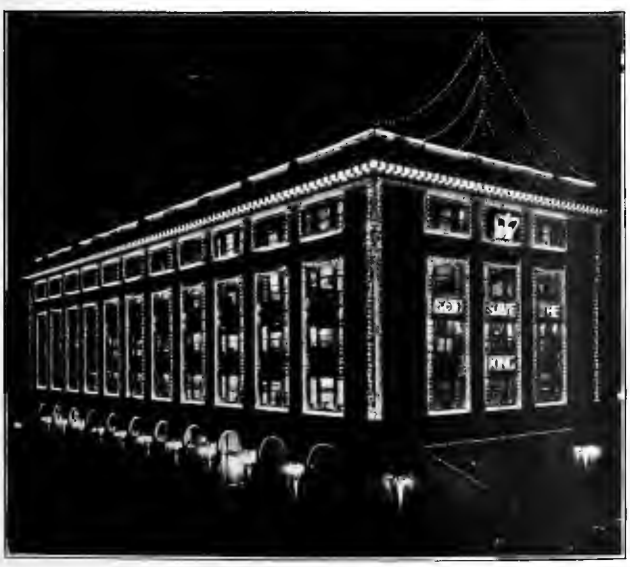
2d. Special case. Best side slope for most advantageous cross section. The problem is to find which side slope or which value of θ will give the best one of the advantageous sections. To find this value of θ first obtain an equation for the hydraulic radius of a most advantageous section in terms of θ and A. Take derivative of r in terms of θ, from which $\cos \theta = \frac{1}{2}$, and $\theta = 60$ degrees.

The dimensions of cross sections proportioned to give best hydraulic elements are given in the following table, for various side slopes, in terms of the desired cross sectional area.

Side slope.	Slope Angle.	Depth,	Bottom width.	Width at Water surface.	Length of slope.	Wetted perimeter.	Suitable for
Vertical	90° 00′	$.707\sqrt{a}$	$1.414\sqrt{a}$	$1.414\sqrt{a}$	$.707\sqrt{a}$	$2.828\sqrt{a}$	Flumes
1 on 1¾	60° 15′	$.760\sqrt{a}$	$.882\sqrt{a}$	$1.750\sqrt{a}$	$.875\sqrt{a}$	$2.633\sqrt{a}$	Rock
1 on 1	45° 00′	$.740\sqrt{a}$	$.613\sqrt{a}$	$2.093\sqrt{a}$	$1.045\sqrt{a}$	$2.705\sqrt{a}$	Firm clay
1¼ on 1	38° 40′	$.716\sqrt{a}$	$.503\sqrt{a}$	$2.293\sqrt{a}$	$1.146\sqrt{a}$	$2.795\sqrt{a}$	Firm clay
1½ on 1	33° 41′	$.689\sqrt{a}$	$.418\sqrt{a}$	$2.485\sqrt{a}$	$1.243\sqrt{a}$	$2.904\sqrt{a}$	Coarse gravel
2 on 1	26° 34′	$.636\sqrt{a}$	$.300\sqrt{a}$	$2.844\sqrt{a}$	$1.422\sqrt{a}$	$3.144\sqrt{a}$	Loose earth
Semi-circular		$.798\sqrt{a}$		$1.596\sqrt{a}$		$1.773\sqrt{a}$	Flumes

ELECTRICAL ILLUMINATION AT VANCOUVER.

The recent visit of His Royal Highness, the Duke of Connaught, Governor-General of Canada and his party to Vancouver and Victoria, B. C., was the occasion of great celebrations in which electrical illuminations played a prominent part. The most important illumination in Vancouver was that given at the new office building of the B. C. Electric Railway Company at Carrall and Hastings streets, in the center of the city, a view of which is given in connection with this article.


Illumination of B. C. Electrical Company's Building.

In carrying out this lighting scheme over 5000 lamps were used. The general plan followed was an outlining of the building, as indicated by the view, with a cascade of three rows of lights from the flag-staff to the roof. For the outline strings, 4 candlepower lamps were used and the effectiveness of the display was greatly increased by the row of 40 watt tungsten lamps, located under the coping of the cornice of the upper story, these forming a part of the permanent wiring system of the building. On the ground floor the building was surrounded by a row of 12 regenerative flame arcs placed between each of the arches on the street frontages. On the Hastings street side a special design of a crown in which 200 lamps were used, some being in color, and "God Save the King" in letters two feet high, made an effective addition to the display.

PROGRESS.

"About forty chandeliers in shape like a crown, hung from the ceiling, each carrying thirty-six wax candles. On the King's appearance, all these candles were suddenly lighted and everyone was filled with astonishment at the wonderful and unexpected illumination. Little cords of cotton wool, almost imperceptible to the eye, saturated with sulphur and saltpeter with spirits of wine and other ingredients had been prepared and arranged to carry the flame rapidly from one candle to another. Hardly a candle failed to take fire."—A description of the Coronation of King George II, in 1727, by Cesar de Laussure.

A man stood on the crest of Mt. Wilson. He shaded his eye with his hand and looked far over the plains and the cities to the ocean. The round disc of the sun was sinking rapidly into the deep, and its sheen turned the placid waters and the foam-flecked beach into a blood-red globe. The red ball poised for a moment on the expanse of waters and then plunged beneath the tide. As if by a miracle, the cities of Los Angeles, Pomona, Santa Ana, and as far as the eye could reach to the eastward; to the westward, the shore cities of Long Beach, San Pedro, Santa Monica, Venice, Ocean Park and Redondo all burst into a gleam of artificial light, for such is the world's progress. What is progress? A few giant minds which focused on a great thought brings it into being; a few erratic minds that stumbling over the things of nature, discover its wondrous secrets, and the myriad smiths, who pounding on their little forges, are hammering out the great destinies of the world. Pound well, ye little smiths at your little anvils, for it is you who are forging the progress of the race.—Chas. H. Peirson in Edison Current Topics.

LEGISLATION VS. REGULATION IN ELECTRICAL DISTRIBUTION.

Discussion of paper by J. E. Macdonald, presented before the Los Angeles Section of the American Institute of Electrical Engineers, October 29, 1912, and published in these columns on November 2, 1912.

Geo. A. Damon (chairman)—We have started off this year in a very appropriate manner. In listening to this paper, it has occurred to me that many more of our meetings should be given over to the discussion of vital problems, such as our engineers are trying to solve from day to day. It is evident that purveyors of public service in California are engaged in great undertakings, not the least of which is their effort to obey the mandates of different state and municipal authorities. Our secretary, Mr. Northmore, has agreed to open the discussion of this paper.

E. R. Northmore: First, I want it distinctly understood that I am not opposed to Chapter 499 or Chapter 500, regulating overhead and underground construction, nor am I opposed to any law which makes overhead or underground construction safer and less hazardous. Anyone who has participated in electrical work for the past 15 years and has seen and investigated numerous electrical accidents, will welcome any law that will increase the factor of safety and offers the chance of saving one lineman's life.

There are some of the paragraphs in Chapter 499 which are not clear and which, in my mind, conflict, and I would like to see these conflicting points cleared up so that they could be interpreted in an intelligent manner, so that we could go ahead and construct our lines without danger of having to reconstruct them again owing to a different interpretation of the law by some other lawyer or judge. If the law could be amended, or better still, if the law was repealed, and the entire jurisdiction of line construction placed under the State Railroad Commission, I believe that all parties would be better off and that the line construction of this State would in a few years, be the best of any in the United States, for, with a body of practical engineers to whom to appeal and explain matters, there is no reason why the companies and everybody interested could not do construction work which would be safe and sane and, at the same time, not work a hardship upon anyone.

Section (1) Paragraph (c) is the one which gives the most trouble and which is the hardest to interpret. The first part, which provides for a clearance of 4 ft. between wires of less than 600 volts and wires of over 600 volts, is all right and should be lived up to, except in buck arm construction. I believe that buck arms should be allowed to be placed 2 ft. below the line arms, and low voltage wires be allowed to be maintained within 2 ft. of high voltage wires where attached to buck arms. This would clear up one of the worst features. It is almost impossible to construct a combination line and attempt to buck-arm from a main line with secondaries of 500 volts power wires, as it is necessary to place our line arms 8 ft. apart, and on streets where there are three lighting companies and two telephone companies this clearance cannot be obtained.

This clause also provides that combination companies may place their arms 3 ft. apart and maintain high voltage wires 3 ft. from low voltage in a horizontal position. This makes bad construction. The specifications say the arms shall be 3 ft. apart, which actually makes them 41 in. from center to center. Consequently it would be better for the companies to place their arms 48 in. apart, as this extra 7 in. saved does not give any more space on the poles, and by placing arms 3 ft. apart it makes construction much more expensive and not as safe. The law says that in this style of construction all high voltage wires shall be on one side of the pole and the low voltage on the other.

I have in mind a line which we are now rebuilding, where we have nine No. 00 2200 volt wires, fifteen arc wires and two 500 volt power wires. If we had placed our crossarms 41 in. from center to center and used the standard 8-pin arms, we would have used six 9 ft. crossarms, with four wires on each arm on the street side, and would have used something over 20 ft. of the pole, and with another company under us with three arms of wires, this impossible construction would have been a good example of what a law controlling line construction without detailed specifications covering each point of the construction work is. Instead of constructing this particular line in this manner, we simply placed our line arms 2 ft. apart and filled three of them with high tension wires, arcs and primaries, and then placed an arm 4 ft. below and placed the 500 volt power wires on this arm. The next company coming on our pole will go 4 ft. below this arm with its lines; but, are we living up to the law?

Another question is this: Suppose two companies should build a line according to these specifications; that is, place their arms 36 in. apart, and later on one company should purchase the interest of the other company, would it be necessary for the company to reconstruct this line and put its arms 4 ft. apart? For this reason, I do not believe it is practical for any of the companies to attempt to build their lines according to this part of paragraph (c), which allows the arms to be placed 3 ft. apart, but that the companies should build as though one company only were on the poles; that is, at all times, maintain their low voltage wires 4 ft. from high voltage.

I would like to ask Mr. Macdonald to clear up some of the disputed points in Section (1), Paragraph (c).

With two distributing companies on one pole, if we keep our low voltage wires 4 ft. from the high voltage wires, is it necessary to keep the high voltage wires on one side of the pole only?

With high voltage wires 4 ft. from the low voltage wires, can we place our arms, which have only high voltage wires on them, 2 ft. apart, just so the low voltage wire is put on the arm which is 4 ft. from the high voltage wires? In other words, in combination work, if we keep our high voltage wires 4 ft. from our low voltage wires, as provided for in the first part of paragraph (c), cannot we build and maintain our combination lines with the same construction as provided for in the first part of this paragraph? Does the 36 in. provision, and the provision for high voltage wires to be on one side of the pole, only apply when arms are put on the pole less than 4 ft. apart?

What is meant by a distributing company in this paragraph (c)? Would a lighting company's high line, or a railway company's high line be classed as a distributing line on a combination pole, if the company who owns the high line had no other wires, than the high line wires on the pole? Take for instance where one distributing company has a high line on top of a line of combination poles, and a second distributing company makes combination on those poles, would it be necessary for this second company to place all its high voltage wires on one side of the poles, and all its low voltage wires on the other side of the poles? If that is the case, would not the distributing company who owns the high line be compelled to place its entire high line on one side of the poles also?

In conclusion, Mr. Macdonald states that our cost of construction has been increased ten per cent. I think twenty-five per cent would come nearer to it. It does seem too bad that we have to reconstruct all our line work during the next four years, when, within the last five years, the Joint Pole Committee of the City of Los Angeles has reconstructed over half the line work of this city on joint poles. They have done the construction work according to the National Electric Light Association specifications and have removed about 30,000 poles. In fact, I do not believe this law should be retro-active but should apply only to new work. And, I be-

lieve, the utility companies are going to have hard work in getting different public utility boards to allow a rate which will pay for the additional expense in tearing down good line construction and putting it up again. I have made a rough estimate of the cost of reconstructing, and am sure that Mr. Macdonald's estimate of half a million dollars for reconstructing this city is not too large, and this means that at least $250,000 of the money is to be spent for reconstructing work which has been put in within the last five years, and which is now up to the specifications of the National Electric Light Association on joint pole work.

The Chairman: We shall probably expedite matters if we proceed with the discussion, and Mr. Macdonald will be given an opportunity to close the discussion and answer all questions. We would be very glad to hear from Mr. Cunningham.

R. E. Cunningham: Mr. Macdonald in his paper has referred to paragraph (c) in regard to the color to be used in painting crossarms which carry high voltage wires. Most of the light and power companies in Southern California have adopted the general practice of painting crossarms standard green color and made use of the alternative given by the law, of installing on these crossarms the enameled iron "High Voltage" sign rather than the use of crossarms painted yellow. It was believed that the general use of yellow crossarms on the streets and highways of the country would meet with the disapproval of the general public as it makes the pole lines very noticeable, whereas the green cross arms tend to blend with the surrounding landscape and certainly produces a much more pleasing effect. There has been one case, however, where the Southern California Edison Company has found, after a year's trial, that the enamelled iron signs are not satisfactory. This condition exists where lines are installed along the beach in a very foggy district. The signs were practically destroyed within a year, due to the action of the salt fog. In this particular case it will be necessary to make use of crossarms painted yellow and to break the standard which has been adopted.

If these matters were regulated by a State Commission rather than fixed by legislation, there is no doubt under the conditions mentioned above, that permission could be obtained for the stenciling of the high voltage sign on a green crossarm as a stencil sign would give satisfactory results. This is only one particular instance which would go to show how much more satisfactory it would be for matters of an engineering nature to be controlled by a commission who could always be called upon to make rulings to cover particular cases. All practical engineers will agree that particular conditions will always arise which will differ from any which have been considered heretofore and will require special consideration and methods. With these matters controlled by a fixed legislation it allows no recourse other than to adhere strictly to the letter of the law.

One further point in regard to this particular paragraph, is the fact that it specifies that all high voltage wires must be installed on yellow arms or arms bearing the high voltage sign. Supposing the yellow sign to have been adopted as standard, there is nothing in the law which would prohibit the placing of low voltage wires on the same color of arm. In fact, when crossarms are sent out from the storeroom and installed on the line it is impossible to state in all cases just which crossarm would be used for supporting high voltage wires and low voltage wires, the result being that a yellow arm could be adopted for supporting wires of all voltages and the real purpose for which the rule is made is not accomplished.

The Chairman: We have with us tonight the representative of the Power Bureau of the city. Will you let us have your views Mr. Scattergood?

E. F. Scattergood: There is good reason for believing this the state law is inadequate as a guide to overhead construction. From the information I have at hand it occurs to me that the law practically compels joint pole construction and yet does not adequately provide for conditions making such construction possible. In matters of this nature it is extremely doubtful if the desired results are to be obtained by legislation. The advance of the electrical art is so rapid and the legislative process is often so slow that it seems right that such matters should be left to a commission with competent engineers to differentiate between what is or is not correct construction. It is probable that certain fundamental principles could with impunity, be enacted into law, but the application of a complex statute can scarcely produce results.

H. B. Lynch: The title of Macdonald's paper "Legislation vs. Regulation in Electrical Distribution" is broad enough for several evenings' discussion, including, as it does, the whole scope of the Public Utilities Act.

We are all in favor of enactments which will form a standard of line construction, and which will conform to good engineering practice and add to the safety of our lines, without making our construction unnecessarily expensive.

Chapter 499 in general does add to the safety of our constructions, but is faulty in several respects.

In going over the law the first point that attracts attention is the 13 in. clearance provision. This might well be made 15 in. for high potential wires, as most companies have voluntarily adopted this clearance.

It is unnecessary to say much about paragraph (c), referring to distances between high and low tension wires, as that has been already covered by those who have spoken.

The section which calls for high voltage signs on crossarms in cities carrying 10,000 volts and over is unnecessary, as the insulators themselves give ample notification of the voltage to all who have any occasion to climb the poles.

Paragraph (h) of Section (1), relating to highway and other crossings of high tension lines is entirely too drastic, as it practically requires that all high tension lines be strung with No. 0000 wire. In a recent instance where a few miles of high tension line was contemplated by us, this provision would have added fully $10,000 to the cost of the line, above what good engineering practice and a proper regard for safety required.

F. B. Lewis: Mr. Macdonald has fully pointed out the various clauses which go to make up Chapter 499, Statutes of California, 1911. Owing to the ambiguity of this law and the numerous interpretations which might be obtained therefrom, it is my opinion that it should be either redrafted or repealed at an early date.

I believe that all operating companies will bear me out when I state that proper regulation is to be desired, and also that better results will be obtained from regulation rather than legislation. Proper regulation will produce standardization, which in turn stands for efficiency and economy. We are all striving toward standardization and probably no one thing will bring about a general standardization amongst all operating companies as quickly as proper regulation.

There has recently been passed by the city council of Los Angeles Ordinance No. 26092 which makes necessary certain undesirable construction; as, for instance, the use of guy stubs instead of anchors. As near as I can determine this ordinance was passed by the council without referring the same to the Board of Public Utilities, and I simply mention it to emphasize what I have stated above, that better results will be brought about when we have regulation by skilled technical bodies rather than legislation.

No matter how conscientious legislative bodies may be, it is not to be anticipated that they should possess the technical knowledge which comes only with many years of practical experience along the special lines under consideration.

T. A. Panter: I am not in such close contact with the subject under discussion as a number of the gentlemen pres-

ent, but I believe Mr. Macdonald has covered the ground very thoroughly in his paper this evening. It seems to me that if it is impossible for those who are in such close contact with the work to understand the meanings of the various sections of the acts as passed, and who are continually in touch with these problems and endeavoring to solve them, it is going to be far more difficult for the rest of us to understand their meaning.

I believe that a solution of the problem would be to have a representative, or representatives, from engineering departments of corporations and municipalities, and other engineers in the State, get together and draft a set of specifications or rules which would remove the objectionable features, making a law or set of laws which would be practicable and not a burden, after which the influence of all parties should be concentrated toward having these matters placed in the hands of a competent board or commission, such as the Railroad Commission, and submit such plans or specifications to that body.

E. Y. Porter: I am very glad to be present this evening, and have had one or two points cleared up for me which I was reluctant to consider as settled from my standpoint. I have been considering myself all kinds of a fool for not being able to secure a satisfactory ruling on Paragraph (c), Section (1). Having relieved myself of this personal stigma, I am willing to go forward to the solution of the real problems of the statute. I certainly agree in the fullest extent to the sentiment which has been repeatedly expressed here tonight, to the effect that it is impracticable to formulate any set of inflexible rules covering practical construction in any art which is constantly changing and progressing, and to incorporate such rules into statute law. I am sure that none of the utilities companies have any desire to evade the law, nor to depart from good practical construction. What we want is not to combat or evade the law, but to know how to comply with it. If, after over a year of study and experimenting, no two engineers can agree in all respects as to what construction is permitted or forbidden by this law, it would certainly seem that either a revised law, or a comprehensive interpretation of the law as it stands by competent authority, is absolutely necessary both to the operating companies and for the safety of the public.

If we could have some competent authority to whom disputed or ambiguous points of the law could be submitted for interpretation, or, better still, if the present law could be repealed, and the whole matter placed in the hands of the Railroad Commission, or similar body, I am confident that it would not take long for the Commission and the engineers of the various companies to get together and formulate specifications, which would not work any hardship upon the utilities companies, and would safeguard their employes more perfectly than can possibly be done under the present state law.

In regard to hanging transformers upon pole lines carrying primary and secondary wires upon the same crossarm, referring to Fig. 3, it will be noted that one wire to the high tension side of the transformer is brought across close to the pole on the under side of the crossarm. This wire is supposed to be heavily insulated. Can we expect that it will always be so insulated? Practically, I think we will find it is usually an ordinary weather-proof wire.

The chief intent of Paragraph (a) of the law is, evidently, to keep the climbing space on the pole as free as possible from high tension wires. It would, therefore, seem preferable to hang the transformer upon crossarms at right angles to the line arm, as shown in the accompanying sketch. This construction, it will be noted, keeps all wires entirely clear of the pole or crossarms, and permits the lower crossarm to be used as a branch line "buck arm," or house service arm. Manifestly, the same construction can be used for hanging two transformers for open delta, three-phase connections.

I believe that the provision requiring crossarms carrying high voltage wires to be painted yellow, or in lieu thereof, to have a high voltage sign attached, does not tend to additional safety, on account of the fact that if the former system, which is undoubtedly the simplest, is followed, there is still nothing to distinguish between high voltage and low voltage wires, which may be carried on the same crossarm, unless half of the arm is painted another color, which would give a grotesque appearance to the line, to say the least.

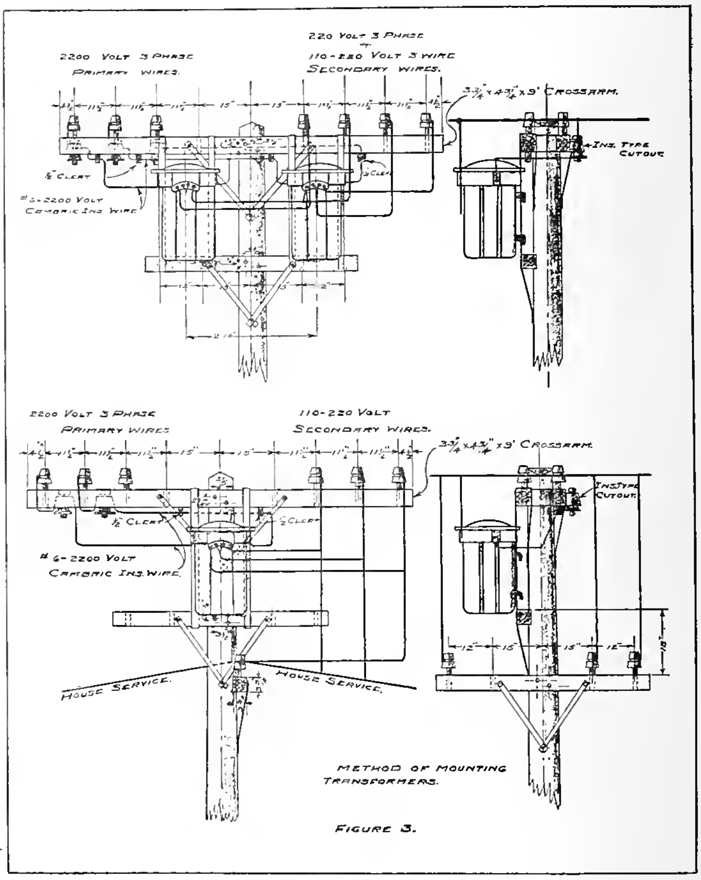


Fig. 3.

I understand that some steps have been taken towards securing a revision of the law, and I am sure that it would be of the greatest interest to all present to know just what has been done along this line.

The Chairman: If there is no further discussion, I shall call on Mr. Macdonald to satisfy the inquiries which have been made concerning this law.

R. S. Sorenson: I would like to know who originated this law; who is responsible for this beautiful piece of work?

J. E. Macdonald: Prof. Sorenson's question being the easiest one to answer, I shall endeavor to enlighten him first, although the majority of us know the complete history of these laws.

The overhead and underground laws had their origin in three bills, numbered 312, 313 and 314, which were presented to the state legislature early in 1911, by the labor organizations of San Francisco, where similar legislation had been enforced by ordinance for some years. Bills 312 and 313, by legislative action, became Chapters 499 and 500 of the 1911 Statutes. Bill 314 provided for the creation of an official, to be known as "state electrical inspector," who was to have authority to appoint an indefinite number of deputy inspectors, the latter to act without compensation. This bill was withdrawn in committee. It should be stated further, however, that the labor organizations deserve credit for their part in this legislation. Although the law has been in effect for one year, there has been practically the fullest cooperation on their part, notwithstanding the fact that the

law offers excellent opportunity for coercing refractory corporations to accept the dictation of organized labor. I merely mention this fact because the inquiry has been made, and because this phase of the subject was uppermost in our minds when these companion bills were introduced into the legislature.

In considering this Paragraph (c), the main idea to be kept in mind is the probable intent of the authors of the bill, which was to provide 4 ft. clearance between wires carrying more than 600 volts and wires carrying less than 600 volts. I believe, therefore, that the common sense solution of this paragraph (c), as given by Mr. Northmore, is quite correct; that is, the placing of all primary and street lighting circuits on crossarms, spaced, say 2 ft. apart, with all low voltage wires on crossarms, which must be spaced at least 4 ft. from the primary arms, but not more than the standard spacing of 2 ft. from each other.

I do not believe that Paragraph (c) was intended by the authors to apply to anything but distributing circuits, and any reference to high tension circuits, exceeding, say 6600 volts, should be disregarded, as, at this voltage and above, the standard of construction must necessarily be raised so as to come without the range of specification provided for by Paragraph (c). I do not maintain that this is a legal interpretation, but the section is so ambiguous that a legal decision must necessarily be very remote from solving the problem fully. Until some better solution is offered therefor, I would suggest the adoption of the 4 ft. spacing, between high and low voltage crossarms, which is a more rigid clearance than that providing for joint construction, and should, therefore, not raise any question as to its legality. I would not recommend putting primaries and secondaries on the same crossarm, except where it is necessary to maintain but one arm. The primaries may be bucked in the usual way, directly above or below line arm, and the secondaries should be bucked on separate arm 4 ft. below. Where so much space on pole is not available, it is customary to buck primaries only, and take care of the branch secondaries by an additional transformer. I believe Mr. Northmore is using this method quite extensively.

With reference to Mr. Northmore's inquiries regarding the interpretation of paragraph (c). I do not feel that I am able to clear up this matter to his satisfaction. During the past year he and I have agreed to disagree as to the interpretation of some of the most important points. However, I do not anticipate that he will invite a jail sentence for himself or any other member of his company, by continuing his present method of construction. Not that it is absolutely correct, but it is probably closer to the intent of the law than the law itself. Mr. Northmore's difficulty, and his solution of it, are shown in Fig. 7. In one drawing it will be noted that all arms are 36 in. apart, primaries and high voltage wires all on side of the pole, low voltage on the other. In the other drawing is shown what is considered the correct construction, and complies with the first portion of Paragraph (c), Section (1), but not with the portion providing for joint construction.

It would, indeed, be very interesting to know what the committee, that drafted the National Electric Light Association's specification, would have to say about this law. This specification, which has become a National standard, was gotten up to provide for the severest climatic conditions, much severer than anything in the populated districts of California. It has never been suggested before that large clearances make for maximum safety. There is a certain safe clearance, which it is not reasonable to exceed and, personally, I do not believe the National Electric Light Association's specification is very far from the correct one in this respect.

I have in mind, a corner in this city, where, to reconstruct and comply with the state law, and other proposed regulations, would require space of 56 ft. on pole for wires of two companies only, not allowing for any cross leads. The clearance from top of rails of the railroad, at this point, must be not less than 26 ft. Allowing for 8 ft. length in ground, this would demand a 90 ft. pole. The poles used in this lead as a matter of fact are now 60 ft. poles and the clearances demanded would produce such grotesque construction at corners that some other method—probably underground—would have to be adopted to overcome this condition, the cost of which might be prohibitive.

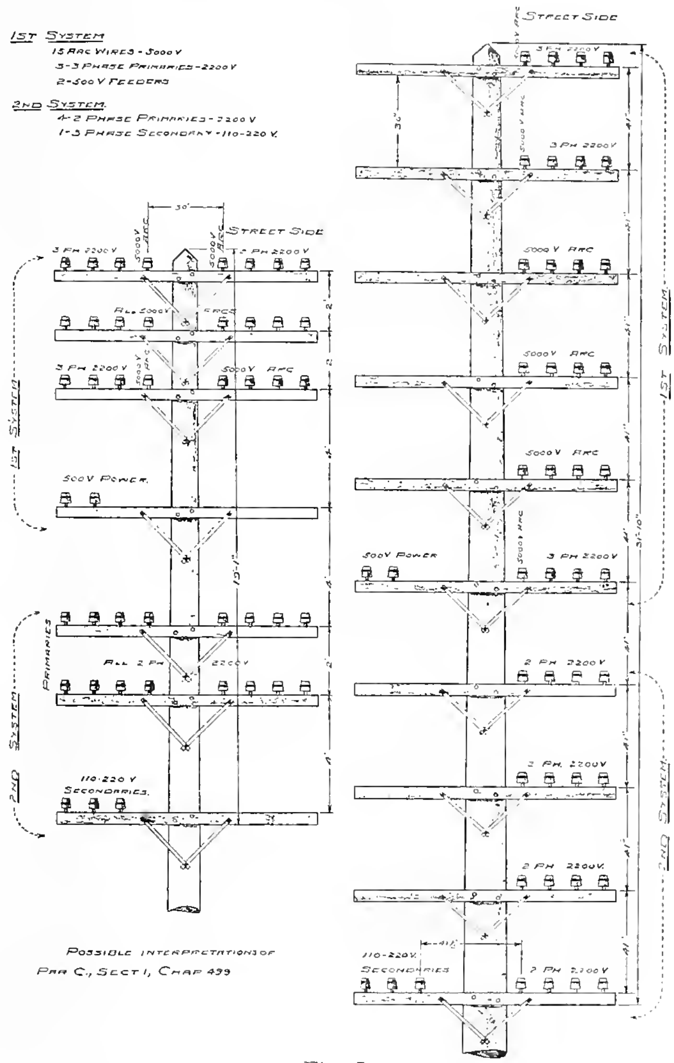


Fig. 7.

I have been much interested in Mr. Porter's remarks, although I do not exactly approve of his method of mounting transformers; that is, on the side of the pole. Mr. Porter's method is shown in Fig. 8. I believe a comparison between this and Fig. 3, will show its disadvantages. When one or two transformers are placed on one side of a pole, it throws a load across the line if pole is not perfectly straight. The pole is also harder to climb and, I believe, there is more danger in connecting a transformer in the manner shown. When we are mounting a transformer in a station, or any inside location for that matter we are very careful to have our wires installed in the neatest manner possible and great care is given to securing the best possible material for making connections. There is no reason why our overhead line construction at vital points should not receive equal if not greater care in its installation. The lead or jumper wires shown in Fig. 3, are of varnished cambric insulation, and are safe for 15,000 volts.

Just one word more, with reference to Mr. Porter's question as to what has been done in regard to securing a revision of the law. We have made what might be called great progress in this direction, in, that all wire using companies in California are practically agreed as to what con-

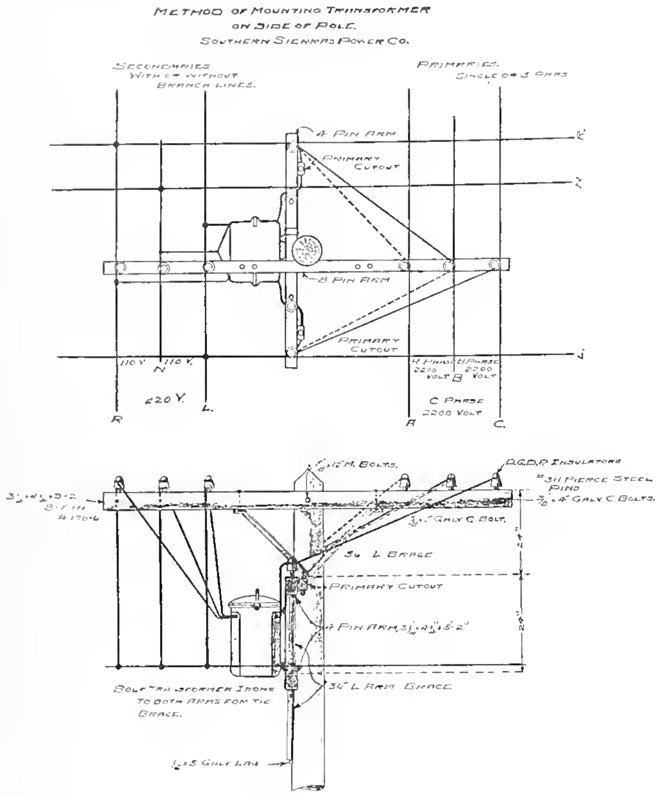


Fig. 8.

stitutes a safe law. This is certainly progress. They are anxious to adopt any rational suggestion looking toward the safety of their employes.

Many good suggestions have been made tonight, but unless such suggestions are acted upon, we shall not obtain any results. Mr. Panter's suggestion that a committee of engineers, in various lines of work, take up the investigation, is valuable. They could prepare a set of specifications which would possibly be even better than that of the National Electric Light Association. I would even go so far as to suggest permitting such a committee, to be limited to the National Electric Light Association's specification, and the state law, using the maximum clearances provided by the latter, with proper modifications, to prepare a complete specification for overhead construction in California. If this were done, we might look back without regret upon the difficulties we are now encountering in seeking to obey the mandates of state and municipal authorities.

B. F. Pearson: A great deal has been said and many criticisms directed at Chapters 499 and 500 of the State Code, yet perhaps if all of the facts were known everyone concerned would feel that at least a tremendous step had been taken in advance of anything prior to said date, which would tend to a united effort (on the part of the utility companies operating in California), for standard construction.

Three elements harmoniously united in effort are absolutely essential in the proper drafting of specifications covering uniform construction of pole lines, underground conduits, and other structures necessary for the transmission of electrical energy in any form: viz., the public, the utility companies, the employe.

Prior to the 1911 session of the California legislature these elements were not united. There were almost as many standards of construction as there were companies; the standards varying with the difference in degree of intelligence, the difference in financial conditions, character of property, etc., and in many instances the standards of construction of individual companies reflected an utter disregard of the public safety, and the life and welfare of the man on the pole, and between a possible united desire for safe construction on the part of the utility companies, and the determined effort on the part of the "man behind the gun" to do something, there was a great gulf fixed. A few feet added to the length of a pole or cross-arm meant to the man on the ground the difference between safety and hazard, and it is conceded that a long time would elapse before all of the companies operating in California would unitedly petition the California legislature to make laws, laying down a standard of construction which would be uniformly satisfactory and safe, and it is not hard to believe that tremendous difficulty would have been involved if the employes, whether represented by organizations or not, had attempted to bring the companies together. They would have met with failure, and I understand that this proposition was given serious consideration by the trades organizations involved, but given up as a hopeless task; hence it devolved on the "knight of the spur and the come-a-long" to get busy. From my intimate knowledge of the circumstances immediately preceding the passage by the 1911 session of the legislature of certain bills governing overhead and underground construction, the sentiment prompting those who drafted (?) the bills and saw them through the legislature and senate was ninety per cent protection to the worker, and ten per cent work for the worker. As one of the labor union proponents, lobbying for the bills, put it, "Hell, what's a few dollars, compared to a few funerals?" It must be admitted that one cannot look on the disfigured features of a fellow employe, after he has been "taken off the line," and perhaps follow him to the "little green meadow," without wishing most fervently, that pole line construction was in every essential respect "safe," and damning, inaudiably at least, every interest which appeared to oppose "safe" construction.

A great many abortive attempts at legislation have been made in California covering this particular question, but unfortunately the attempts were made in the spirit of prejudice, by unwise representatives of trades' organizations, who appeared to be prompted by a sentiment, ninety per cent to "get even" with the companies, and ten per cent something else. Consequently wherever legislation was attempted governing the regulation of line construction, etc., opposition was developed, which all resulted in convincing the worker that if he "got anything" he must do it with the soft pedal on; hence the fact, that the "legislative committee" of the Brotherhood of Electrical Workers, who were responsible for the laws in question, worked secretly, and strange as it may seem, did not extend to the utility companies the courtesy of informing them of their plans, asking their cooperation, or their approval, of the bills before their passage.

It is generally conceded that the 1911 session of the California legislature differed from that of any other preceding it. Business interests had, to a large extent had their day, or sessions, as the case may be. One of the distinguishing characteristics of the 1911 session being, that the hero of overalls and brogans had a "look-in," and they were not slow to take advantage of it; (from all I can gather these men had a perfect right to do this, it appearing on investigation, that they were enfranchised citizens of the commonwealth of California.)

Considering all of the circumstances, it is not to be wondered at that there are a number of points in the law, as it now stands, open to criticism. It may be well to remember, however, that the original bills were hurriedly prepared by a few non-technical electrical workers, and the subject matter whipped into shape by a gentleman who was then the attorney for the Teamster's Union of San Francisco. It is quite likely that he also was non-technical, at least in electrical engineering, and if the law as it now stands is somewhat confusing and conflicting, which is admitted, it is both comprehensive and conservative, and absolutely consistent, compared with the original bills which went to the legislature for their first reading, and which later were amended.

I have been asked to give a brief outline of the situation as I saw it in Sacramento, during the "struggle," and my relations with the Legislative Committee of the Electrical Workers, etc.

My first knowledge that legislation was being attempted was at 2:30 p. m., January 28, 1911, when a file of correspondence was handed me by my company, including drafts of bills Nos. 312, 313 and 314, with instructions to proceed to Sacramento, and do all that I possibly could in preventing unwise legislation; at the same time being given to understand that my employers were heartily in favor of some safe laws governing electrical construction.

After arriving at Sacramento I found the bills had been presented to the legislature, and in turn referred to the Committee on Labor and Capital for discussion, etc. I attended the first meeting. Contrary to expectations I found very few representatives of the power companies present, in fact only two other power interests being present. The proponents of the bills, the Legislative Committee of the International Brotherhood of Electrical Workers, were present to "back" up their demands for legislation. The Committee on Labor and Capital were in sympathy with the proponents; one member of the committee being a lineman; the second member of the committee being an electrical worker of another kind; the chairman of the committee being legal counsel for certain labor organizations affiliated with the International Brotherhood of Electrical Workers. The attitude of the committee, however, was to give everyone an opportunity to express his views. My business was to express my views, and I did so in unmistakable terms, with the result that the Legislative Committee returned to San Francisco at the end of the first week, and reported that they would have to get "that fire-eating blankety-blank from Los Angeles out of the way, if they ever expected to get anywhere."

To cut the matter short; later I made advances to the Legislative Committee, stating to them most clearly that I was there to either defeat the bills entirely, or to assist them in amending them so that they might be at least reasonable in their demands. The result of our conference being that I was later asked by the Legislative Committee of the International Brotherhood of Electrical Workers to act as chairman of the joint conferences which we determined to hold between the committee in question and representatives of power, telephone and telegraph companies, to discuss the amendments which were necessary.

The original bills were, from many standpoints, absolutely objectionable and the proponents of same arrived at this conclusion after many friendly conferences. The time, however, was short. The bills must be amended, and I promised these men in good faith that I would stand with them if they would amend the bills in a way that would not be absolutely arbitrary, and stand I did. The amended bills, however, as finally drafted, still contained much that can be improved upon.

In my letter to Hon. Hiram W. Johnson, Governor, in response to his inquiry, asking me to give him the benefit of my views on the bills in question before they went too far, I stated:

"I am presuming that you do not care to have me go into much detail regarding the matter, and that you wish my opinion from two standpoints, namely, the necessity for bills of this kind, and the scope and character of the bills in question.

"Regarding the first point, I beg to say that unquestionably there is need for proper legislation covering the construction of electric pole lines, used for distributing electric current for power or light, also for pole lines carrying telephone, telegraph or signal wires. At the present time there is no standard for the various interests to work to, with the result that in many instances an almost criminal disregard for the safety of the men who are called to work on pole lines is evidenced; these conditions are very apparent in many of our cities. While the record of accidental deaths from electrocution, and deaths arising from accidents of this character, will show that a large number apparently are purely accidental, it will be found that in many instances a proper regard for the safety of the workmen in the method of construction, would have made the accident improbable, and in some instances, impossible.

"I, therefore, contend that proper legislation is needed for the purpose of adopting a standard of construction for the State of California, which will reduce the hazard to life, be practicable, and lend itself to the necessary improvements in the art of electric lighting, etc.; will also be comprehensive, taking into consideration not only lighting wires, but also the main features of construction for high tension circuits, transmission lines, etc.

"Therefore, from the above standpoint, Assembly Bills 312 and 313, in so far as they cover the points noted, are in the line of progress, but the bills are not sufficiently comprehensive, and do not cover various vital points which should be taken care of in the final consideration of the subject; and I am presuming that at some future date, after the Public Utilities Commission of the State of California has been appointed, and have sufficient time, that they will adopt specifications covering all classes of work.

"This brings me to the consideration of the second viewpoint, namely, the scope and character of Assembly Bills 312 and 313. I have referred above to the fact that the bills were not comprehensive, and were not broad enough in their scope. I would refer, first to Bill 312: It will be noted that while careful provision has been made in Paragraph 'C', relating to the clearance which must be maintained between wires carrying more than 600 volts of electricity, and wires carrying less than 600 volts of electricity, no provision has been made for maintaining a proper space between wires carrying high voltages, which are not assumed in Paragraph 'C', as this relates particularly to lighting wires, which are generally 2000 volts or 440 volts. In other words, the proponents of Bill 312 had in mind, particularly, ordinary congested city lighting wires; whereas, the practice is becoming very common, and is almost necessary, to carry voltages on public highways and along thoroughfares, which are in many instances congested residence thoroughfares, up to 15,000 volts, and sometimes higher. It would seem, reasonable, therefor, that the clearance to be maintained between the 15,000 volt wire and the 2000 volt wire is just as important, in fact more so, than the clearance to be maintained between a 2000 volt wire and a 440 volt wire. In all of our construction we maintain a distance of five feet between the high voltage wires referred to, and the low voltage wires of 2000 volts referred to." Etc., Etc.

I am not including my entire letter in answer to the Governor, as it contains much that is of no particular importance at this time. It will be seen, however, that under the circumstances, the best was done that could be done, and it is my opinion that more was accomplished, during the period of the three weeks that the writer was in Sacramento working on this matter, to bring about a better understanding as to the relations which should exist between utility companies and the employes, than had been accomplished for a long time previous, and notwithstanding that the writer is known to the representatives of the International Brotherhood of Electrical Workers as being an "open-shop" advocate, by letters received from him, the fact is very evident that personally they held me in some esteem, for what they are pleased to call a "square-deal," and the further fact that when I had the opportunity, I did not double-cross them. And all that is needed, in my judgment, now, to either amend present laws, or make new ones which will be entirely satisfactory to the public utility companies and the employee, is cooperation, undertaken in the spirit of real tolerance, and the spirit of mutual interest. We have had legislation; let us have cooperation, and by all means, let the man who works, and who hazards his life daily, be given an opportunity to express his views, and have them, as far as they are practicable, incorporated in said laws.

I wish to add further, that after meeting and becoming acquainted with the executive officers and the legislative committee of the trades organizations of Northern California, who were present at Sacramento, I found them to be tolerant, square, generous and gentlemanly. Let us have cooperation.

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POWER AND GAS

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895
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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Talking in the Other Man's Talk

In Holy writ it is recorded that the greatest engineering task in the early dawn of history was interrupted and absolutely abandoned, due to a confusion of tongues. Many a modern tower of Babel is, for similar reasons, either hindered in its growth or actually deserted before the completed engineering triumph can be made of maximum use to man. Instances by the hundreds may be found in central station practice. The sales engineer, who goes out to sell his product upon the farm, imbued with the importance of high sounding technical terms, may occasionally knock his victim down with the butt end of his pistol. Only seldom, however, does he attain the permanent results desired. In the engineer's mind a clear mental vision may exist of the financial gain that will result to the farmer should he purchase power for pumping purposes at three cents a kilowatt hour. What a mental picture must be drawn in the farmer's mind, however, after an hour's harangue on power for pumping purposes at three cents a kilowatt-amperes and volts! Shades of droughts and deserted haystacks! No wonder as the time for the supreme decision arrives the farmer glares at the sales engineer with that far-distant perplexed expression which seems to say: "Well, I understand you are working upon a new puzzle, but—what's the answer?"

Talk to him in his own everyday talk and how different! The farmer has in his tract a certain definite number of acres. He knows that the return per acre is the unit upon which his income must be made. It is immaterial to him at what particular price per kilowatt-hour the power company can sell their product, so long as his purchasing the same will bring a greater return per acre than without its use. He knows to a dot what it costs him per acre to plow, to seed, to mature, and to harvest. He is familiar with general market prices of this product. Unless, now, he can be approached in a way that he can figure that the central station proposes to furnish power for irrigation at so much per acre per year, he is all at sea. To make a successful campaign in an agricultural community, the central station sales force must be ready to meet this emergency. In the early introductory stages it is better to sell power directly in a manner which appeals to the farmer according to his process of reasoning. An up-to-date sales-force should be so technically versed that selling power on this basis—a rate that talks to the farmer in his talk—should involve no more uncertainty to the central station than the kilowatt-hour basis. At least, it must be admitted that it involves far less risk to the central station, rich in experience from other communities, than to the farmer who is wholly at loss to judge and must take the word of the central as an assurance for the correctness of the prophesied results. Bread thus cast upon the waters will be repaid in a ten-fold measure. Recall to mind the limits to which the Northern Colorado Power Company has gone in this matter. This company has met with unprecedented success from its liberal policy. It not only sells power at so much per acre irrigated

per year but actually finds it profitable to finance the well-sinking and even guarantee water-striking or no cost to the farmer. Central stations now driving their energetic campaigns in fertile Western valleys will do well to heed the broad policy of assisting the farmer in every reasonable manner possible. They should aid him to make a return on his holdings, even though such assistance does involve at times a material risk. And, above all, in putting an electrical proposition to one versed in agricultural pursuits only talk in the talk used in the daily routine on the farm.

The instance cited above applies to every class of power consumer. Too often the lumberman familiar in units of cost per thousand feet of product, turns down the power salesman simply because he does not care to confess his ignorance of electrical terms. Unconvinced, though the proposition be fundamentally sound, he stays by his first love—the steam engine. Countless other instances may be cited among the possible electric power consumers of our great cities. The most fruitful field—that of the near consumer—as a rule, is the most ignorant of electrical terms.

Money talks—so does the salesman. If the central station desires to receive this pecuniary talk of the possible consumer, a talk befitting the range of mental vision of this consumer is absolutely imperative.

Coordination and not Foreordination

Some engineers believe in foreordination instead or coordination. Their belief is reflected in their works. Possessing highly perfected mental analysis for one class of design, they presume all knowledge. They assume a foreknowing of all events of every class. This is a belief in foreordination, for according to the Standard Dictionary, foreordination is an act of the infinitely intelligent, foreknowing, righteous and benevolent will of God from all eternity determining the certain futurition of all events of every class whatsoever that come to pass.

In the symphony of harmonious design, would it not be better for the engineer, endeavoring to render a perfect composition, to press lightly on the soft pedal when bringing out a melody of a somewhat unfamiliar nature, and thus allow his fellow musicians a fuller opporunity to join in the harmony hoped for? What a salient blessing it would be, if, now that the period of second thought in engineering design, has arrived, coordination of results accomplished could in the future be the ruling passion. The engineering installations of the West stand as monuments of achievement. It is a striking characteristic, however, that in each plant is brought out or emphasized some particular feature which stands head and shoulders above the other parts of the installation. The power plant of the future should combine all of these splendid special features invented by the genius of half a hundred engineers. No one detail should predominate, or be unduly emphasized. The story of the weakest link as being the test of strength for the chain is indeed applicable to the power plant.

Hence, although unduly emphasizing certain links in the power plant layout at times brings an individual halo over the installation, yet to bring up to to standard the weak features in design there to be found makes as a whole an engineering creation far more harmonious and effective.

The Malarkey Commission

Oregon has through its voters enacted at the recent election the socalled Malarkey public utilities act, whereby the railroad commission of that state is given jurisdiction over the public utilities. The new bill requires adequate service and reasonable rates, common using of certain facilities and compensation therefor, valuation of properties, uniform accounting and reports.

The enactment, while largely copied after the Wisconsin Commission law, does not contain the indeterminate franchise provision. This omission may prove the better part of judgment. A recent decision of the circuit court of Dane County, Wisconsin, holds, in what is known as the Appleton waterworks case, that in fixing the price which a city is to pay for the purchasing of a utility, the Railroad Commission must add a value for the indeterminate franchise. Most recent evolution in utility appraisal practically is unanimous that a franchise for which nothing is paid has no value for rate fixing purposes. If the principle upheld in the above mentioned Wisconsin circuit court stands the supreme test, the value of the indeterminate franchise theory may be materially impaired.

The review feature is also missing from the Oregon law. In California a review of the commission's decisions may be taken directly to the state supreme court, without the delay and uncertainty attendant upon a retrial in inferior courts, with a final appeal to the state supreme court. It is regretted that this feature has been omitted.

On the other hand, the citizens of Portland are indeed to be congratulated upon voting down the "home rule" bill, thereby accepting jurisdiction under the state-wide commission. An instance of the ridicule to which the California "home-rule" exposes their municipalities is that of the Pasadena incident. The city of Pasadena recently complained to the California Railroad Commission that the Southern California Edison Company had reduced its rate in Pasadena to a point which makes it impossible for a profitable operation of the municipal lighting plant in that city. The complaint charged that the rate instituted by the Southern California Edison Company is discriminatory in that other municipalities served by this company are charged at a higher rate. The state commission promptly ruled that it has no jurisdiction in the case. Without entering into the merits or demerits of the points at issue, it is clearly evident that Pasadena is placed in an anomalous condition. Here it is seen that a competitor has legal authority, not only over the franchise, but also over the rates of the other—a condition wholly at variance with all principles of justice and equity.

Summing up, then, all the various clauses in the new commission law of Oregon it would seem that this commonwealth is to be congratulated in having a good, workable enactment.

PERSONALS.

Virgil Cooper has resigned as superintendent of the Portland, Eugene & Eastern lines at Salem, Ore.

W. D. Dunsmore, manager of the Pavement Cutting Machine Company, has established his headquarters in the Foxcroft building, San Francisco.

W. W. Briggs, assistant general sales manager with the Westinghouse Electric & Manufacturing Company, is visiting the company's Los Angeles branch.

Hugo Altmayer, president and superintendent of the Farnsworth Electrical Works, has returned to San Francisco after an extended trip throughout the East.

George G. Devore, formerly local manager at Georgetown, Cal., for the Truckee River General Electric Co., recently joined the staff of the Oro Electric Corporation.

A. L. Pond, manager of the Chicago office of the Fort Wayne Electric Works of the General Electric Company, has returned to Chicago, after a brief visit to California.

William E. Lotspeich, Pacific Coast representative of the Colonial Electric Works, has returned to Warren, Ohio, by way of Seattle after an extended visit to California.

H. W. Crozier is expected to return to Sanderson & Porter's San Francisco office this week, after an extended investigation and public utility valuation at Tucson, Ariz.

R.G. McDonald, electrical and hydraulic engineer of the Mono-Home & Canal Company of Mono Lake, California, is a recent San Francisco visitor and is now in Los Angeles.

F. W. Bradley, mining engineer and capitalist, has been elected president of the re-organized Ocean Shore Railroad Company, which is building an electric road from San Francisco to Santa Cruz, Cal.

H. A. Noack, president of Pierson, Roeding & Company, and **F. A. Richards**, manager of the company's car department, are in the northwest, Mr. Richards having returned from an eastern trip this week.

Edward J. Duggan has resigned his position with the Levy Electric Company of San Francisco, as assistant to Mr. Louis Levy, and has taken up new duties at the local office of Holabird-Reynolds Company.

W. Zackert, formerly with the industrial sales department of the Great Western Power Company, is now acting as secretary to W. W. Briggs, assistant general sales manager of the Westinghouse Electric & Manufacturing Company.

John M. Eshelman and Max Thelen, members of the California Railroad Commission are attending the first convention of the recently organized Association of Public Utility Commissioners at Washington, D. C., November 19-23.

W. L. Goodwin, vice-president and general manager of the Pacific States Electric Company has returned to San Francisco after completing arrangements for his company to take over the Seattle store of the Holabird Electric Company.

R. B. Wolverton has assumed his duties as wireless inspector for the Pacific Coast, with offices in the Custom House building, San Francisco, succeeding **R. Y. Cadmus**, who has been transferred to Washington, D. C., at his own request.

F. G. Baum, chief engineer with the Pacific Gas & Electric Company, has returned to San Francisco after inspecting the work at the new Spalding dam. The engineering departments of the company have been housed in larger quarters on the seventh and eighth floors of the Grant Building.

H. P. Pitts, commercial engineer with the Pacific Gas & Electric Company, will attend the convention of the National Commercial Gas Association at Atlanta, Ga., on December 2-6, 1912. He will take credentials from the Pacific Coast Gas Association and the Panama-Pacific Exposition Company requesting that the association hold its convention at San Francisco in 1915.

Ralph U. Fitting, formerly with the engineering department of the Electric Bond and Share Company for four and a half years, has been engaged by Harris, Forbes & Company, New York bankers, as engineer. At the time of his resignation he was assistant chief engineer and had charge of all the gas construction work done by the company. Previous to graduating from Stanford University in 1906 he had been connected with the gas department of the Independent Gas & Electric Company of San Francisco; the engineering department of the Northern Pacific Railway Company at Tacoma, Wash.; the transmission line construction of the Puget Sound Power Company on the Electron Development; Tacoma substation construction for the Tacoma Railway & Power Company, and the drafting department of the Pacific Gas & Electric Company in San Francisco. After graduation he became identified with the gas business again and accepted a position as draftsman to the Portland Gas Company of Portland, Ore., and held the position of superintendent of distribution when he resigned about two months before coming to New York.

MEETING NOTICES.

Portland Section, A. I. E. E.

The next regular meeting of the Portland Section, A. I. E. E., will be held in the assembly hall of the Electric building, Tuesday evening, November 19. W. D. Scott will present the paper of the evening on "Leased Wire Service on the Pacific Coast."

Oregon Electrical Contractors' Convention.

The date for the convention of the Oregon Electrical Contractors has been changed to December 17th and 18th, instead of December 10th and 11th, as announced last week, on account of the conflict with the jobbers' meeting on December 7, 8 and 9.

Portland Jovian Luncheon.

The regular weekly Jovian luncheon was addressed by C. C. Chapman, Secretary of the Portland Commercial Club. Mr. R. Hartley acted as chairman. His talk was a brief outline of some of the activities of the Portland Commercial Club in promoting the agricultural developments of Oregon.

San Francisco Engineers' Club

By far the largest attendance hitherto gotten together was present at the meeting of the San Francisco Engineers' Club last Tuesday noon at the Palace Hotel. A comprehensive plan was reported and decided upon, whereby the club will become a permanent fixture with club rooms and hotel facilities. Engineers interested both among the present membership and among coast engineers generally will be informed as to the interesting plans ahead.

Electrical Development League.

The regular monthly meeting of the Electrical Development League of San Francisco was held November 12. The regular routine matters were disposed of and a nominating committee consisting of C. E. Wiggins, H. B. Squires and S. J. Lisberger were appointed to select and make report at the next meeting of the League on nominees officers for the ensuing year. Walter A. Chowen general agent, of the Frankfort General Ins. Co. addressed the gathering on the "Various Phases of the Roseberry Liability Insurance Law and Its Effect Upon the Employers of Labor."

Engineering and Architectural Society of Portland.

The regular weekly luncheon of the Engineering and Architectural Society was held at the Hotel Portland, Tuesday, November 5. The feature of the meeting was an address by F. W. Newell, director of the Reclamation Service. After explaining the principle of storage reservoirs in arid districts to preserve the water for irrigation purposes, he went into some detail as to the money that has been expended by the government in this work and its results. He said that the appropriations, aggregating $75,000,000, had reclaimed 75,000,000 acres, or rather had placed them in a position to be reclaimed.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

SPECIFICATIONS FOR THE INSTALLATION OF MOVING PICTURE MACHINES AT PORTLAND, OREGON.

COMPILED BY F. D. WEBER.
(Concluded)

(f) **Portable Booths.**

(1) **When constructed of sheet metal and angle iron.**

Frame of Booth to be made of structural steel as follows: Four outside horizontal members at top and bottom. Four corner uprights and members supporting roof to be made of 1½"x1½"x¼" angle irons. See mark "A," Figures 1, 2, 3 and 4.

Intermediate uprights to be spaced every 2 feet, and to be made of 1½"x1½" angle irons or 2"x2"x¼" Tee irons. See mark "B," Figures 2 and 3.

Tee irons to which roof is attached to be made of 1½"x 1½"x$^3/_{16}$" Tee irons. See mark "C," Figures 1 and 4.

All joints to be made with a $^3/_{16}$-inch steel plate, to which each angle iron or Tee iron shall be riveted or bolted by the

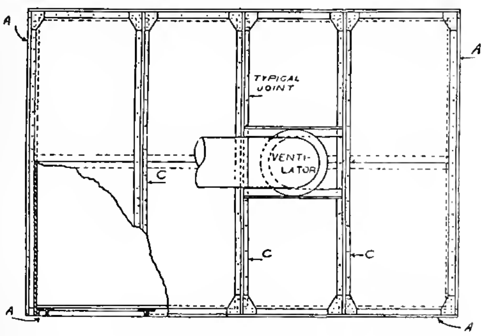


FIG. 1

use of at least two (2) ¼-inch bolts or rivets. See Figures 1, 2 3 and 4.

All bolts or rivets in frame to have flat heads, said heads always to be placed on exterior side of booth; all angle or Tee irons being so countersunk as to accomplish this result.

Frame to be built with a 6'x2" doorway (Figure 2); frame of said doorway to be built of 1"x1"x$^3/_{16}$" angle irons, which are to be joined together by the use of a $^3/_{16}$-inch steel plate similar to that shown in Figure 2.

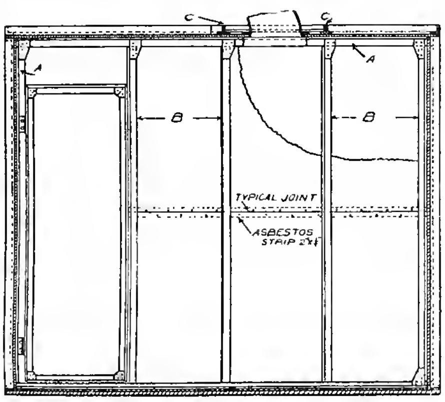


FIG. 2

Covering of Booth. The ceiling, walls and floor must be constructed of No. 22 U. S. Standard gauge (.0313 inches) galvanized sheet iron; all vertical joints between sheets must come over an angle or Tee bars, so that both sheets may be securely fastened to same. Horizontal joints between sheet iron strips may be fastened with riveted lap joints, allowing a lap of 1 inch and rivets placed at least every 2 inches apart. Iron sheeting must be fastened to frame by ¼-inch bolts. This booth must be so located that it will not be within 6 inches of combustible material unless the combustible material is protected by ⅛-inch asbestos. Entrance doors must conform to section (d) and all other openings must conform to section (b).

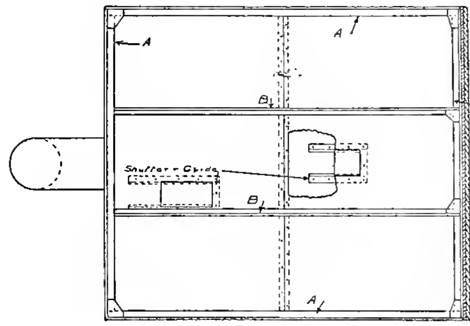


FIG. 3

(2) **When constructed of approved "plain asbestos wood" and angle iron.**

Frame. Same as above for sheet metal booths.

Covering of Booth. Sides and top of booth and door to be covered with approved "plain asbestos wood" of at least ⅜-inch in thickness, said boards to be so cut and arranged that vertical joints between boards shall always come over an angle or Tee iron, so that both boards may be securely fastened to the same. See Figure 6. After booth is com-

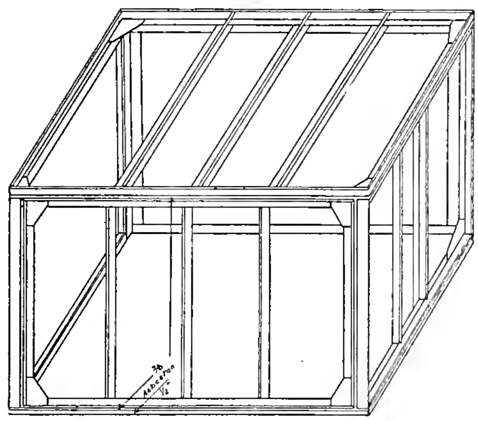


FIG. 4

plete, all openings where combustible material is exposed must be plugged with asbestos cement or equally satisfactory material. When joints of asbestos wood on the outside of booths do not come over angles of Tee irons the cracks between the boards shall be covered by a strip of asbestos wood at least ¼-inch in thickness and 2 inches wide, said strips to be securely fastened to both boards in such manner so as to cover the exposed joints. The above-mentioned strips and all asbestos wood shall be secured in the proper place by the means of proper bolts and nuts, said bolts and nuts to be spaced not more than 6 inches apart.

Flooring. Floors shall be made of two parts, an upper and a lower floor. Lower floor shall be made of asbestos wood, ½-inch minimum thickness. Resting on this floor shall be a floor made of asbestos wood of ⅜-inch minimum thickness. See Figure 7. Joints to be broken in this floor.

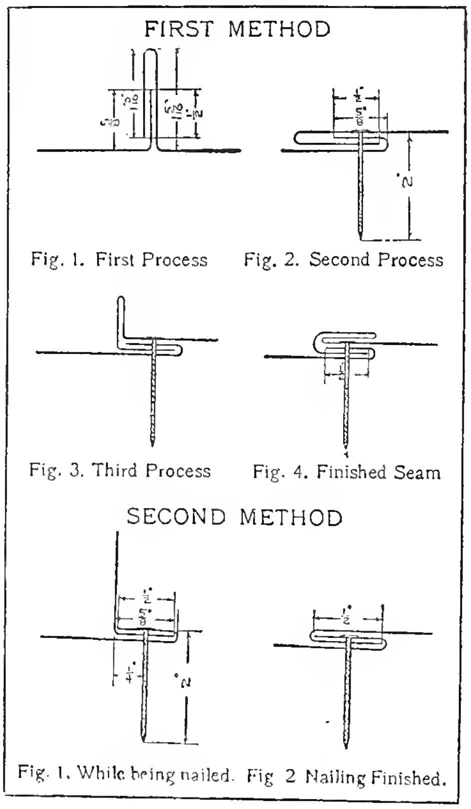
Entrance Doors must conform to section (d) and all other openings must conform to section (b), with the excep-

tion that for the small sliding doors over machine openings that it will be satisfactory to use one piece approved "Plain" asbestos wood of at least ½-inch thickness in place of metal and asbestos doors, as specified in this paragraph.

Asbestos Wood. Whenever asbestos wood is referred to in this pamphlet it shall be understood to mean approved "Plain Asbestos Wood."

(g) **Combination Booth.**

(1) **When picture machine booths are constructed of brick, reinforced concrete or standard hollow tile in combination with asbestos and lock-jointed metal,** it will be necessary to so construct these booths so that the joints between the fireproof material and the metal shall be thoroughly tight. This is to be done by recessing the metal at least 4 inches and with a 1-inch right angle bend at recessed end into fireproof material. All openings must conform to section (b) and entrance doors must conform to section (d), except



FIRST METHOD

Fig. 1. First Process Fig. 2. Second Process

Fig. 3. Third Process Fig. 4. Finished Seam

SECOND METHOD

Fig. 1. While being nailed. Fig 2 Nailing Finished.

where these sections refer to nails, and in these places lead expansion sleeves and bolts must be substituted when guides, etc., are fastened to fireproof material.

(2) **When booths are constructed by using floor joists covered with "ship-lap" for ceiling "backing," the floor being of wooden crib construction, both covered in a standard manner with asbestos and lock-jointed iron, with the sides all constructed of metal, the following construction must be followed for the side construction:**

Metal studding must be placed on at least 6-inch centers for vertical supports and with at least four metal studdings spaced equally distant apart, running horizontally around the sides of the booth. Every cross of studding to be tied with iron wire. The metal studding to be bolted to a 1½"x 1½"x¼" angle iron at top and bottom. The angle irons must be screwed to the woodwork at the top and bottom of the booth with 1-inch wood screws spaced not farther than every foot. The sides to be covered by No. 22 U. S. Standard gauge galvanized sheet iron, the same to be riveted together with a 1-inch lap, the rivets to be not over 2 inches apart. The side lining must be riveted in the same manner to the floor and ceiling covering as above. The side 18 inches apart with 1"x1"x$^1/_{16}$" strap iron riveted to the lining. All door hangings and guides or any attachments must be riveted to the sides of booth in a substantial manner. lining must also be tied to the metal studding at least every

Also around openings in the booth the lining must be kept smooth and free from buckling, and it may be necessary to furnish more metal studding at these points to obtain this condition. Outside walls of booth must be covered with metal lath and cement plaster. Entrance doors must conform to section (d) and all other openings must conform to section (b).

(h) **Methods of Construction Not Specified.**

To avoid all misunderstandings in the future, when any special construction, not covered in this pamphlet is contemplated, the same should be taken up with the Inspection Department of the Bureau.

11. **Machine Stands and Shelves** in booth must be entirely of metal or of wood, covered with the same fire resisting material as the booth itself.

12. **Protective Features.** No waste paper, newspaper, old clothes, rags, or in fact anything of an inflammable character will be permitted in the operating room. The walls and the floors of the operating room must be kept clean; under no circumstances must dust be allowed to accumulate. Waste will not be permitted in operating room; such wiping rags as may be necessary must be kept in approved waste can. Under no circumstances must the operator leave the operating room without first having disconnected the current from the arc lamp of the machine. Smoking is positively prohibited. One chemical extinguisher, 2 buckets water and 2 buckets of sand must be provided.

TRADE NOTES.

The "Holophane Works of General Electric Co." has been adopted as the name of the organization manufacturing Holophane, Holophane-Dolier, Iris, Veluria, Clear-cut and Nobblac Glassware, etc., this being the legal successor to Nelite Works of General Electric Company.

The Pelton Water Wheel Company report an order from the Idaho Consolidated Mines Company for an 850 h.p. Pelton-Francis turbine to operate a 500 kw., 600 r.p.m. General Electric alternator, three-phase, 220 volt, for use in a new plant near Port Hill, Idaho, which is being exploited by the American Smelting & Refining Company. The operating head is about 190 ft. A Pelton oil pressure governor will be operated in connection with a Pelton synchronously operated relief valve to avoid altering pipe line velocities, a heavy fly-wheel also being provided to insure accurate speed regulation to take care of the great variations in load consequent upon running mining equipment.

The Crocker-Wheeler Company has recently installed two 25 cycle, 4500 k.v.a., three-phase, core type butt joint water cooled transformers at the Superior transformer station of the Great Northern Power Company. These transformers were put to a sudden and severe test just a few hours after they were ready to be put into regular service. On one of the towers of the transmission line running to the Duluth transformer station which is tied in with the Superior station the six insulations were shot to pieces by rifle bullets, evidently with malicious intent, thereby putting out of service the transformers in this station. As this occurred just at the beginning of the peak load period each of the two Crocker-Wheeler transformers at Superior had to carry upwards of 6000 kw. until the damaged lines had been repaired and normal service restored.

NEW RULES OF SAN FRANCISCO DEPARMENT OF ELECTRICITY ON EXTERIOR ILLUMINATION.

(Adapted from Rule 83, National Electrical Code.)

In addition to the conduit method for exterior illumination, metal trough construction will be permitted under the following regulations:

Local Rule No. 55.

a. Material.

Must be constructed entirely of metal or other approved non-combustible material.

Sheet metal must be not less than No. 28 U. S. metal gauge.

All metal must be galvanized, enameled or treated with at least three coats of anti-corrosive paint, or otherwise protected in an approved manner against corrosion.

b. Construction.

Must be so constructed as to insure ample strength and rigidity and securely fastened to the building.

Must be so constructed as to be practically weatherproof and so as to enclose all terminals and wiring other than the supply leads. Supply leads must be brought into the body of the structure in approved rigid conduit.

No part of this structure must be concealed or embedded in any manner, but must be entirely exposed on the exterior of the building.

Cut-outs, transformers, unless of weatherproof type, flashers and other similar devices on or within the metal trough structure, must be in a separate, completely enclosed, accessible and weatherproof compartment, or in a substantial weatherproof box or cabinet of metal of thickness not less than that of the structure itself.

Each compartment must have suitable provision for drainage through one or more holes each not less than one-quarter inch in diameter.

c. Marking.

Must have the maker's name or trade-mark permanently attached to the exterior.

d Receptacles (Weatherproof).

Must be so designed as to afford permanent and reliable means to prevent possible turning; must be so designed and placed that terminals will be at least one-half inch from other terminals and from metal of the structure.

Miniature receptacles will not be approved for use in this work.

e Wiring.

Must be approved, double-braided, rubber-covered wire not less than No. 14 B. and S. gauge.

Must be neatly run, and so disposed and fastened as to be mechanically secure.

Must be soldered to terminals, and exposed parts of wires and terminals must be treated to prevent corrosion.

Must, where they pass through walls or partitions of the structure, be protected by approved fitting.

On outside of structure must be in approved rigid conduit.

f.

Not over 1320 watts must be dependent upon final branch cut-out, nor more than twenty-four (24) receptacles on any one circuit.

g. Grounding.

All metal parts of structure must be permanently and effectively grounded.

h. Inspection.

All metal trough construction must be inspected in shop and preliminary approval obtained before erection upon the building.

Note.—Sections "d" and "k" of Rule No. 17 of the "1911 Local Installation Rules" have been repealed.

NEWS OF SAN FRANCISCO ELECTRICAL CONTRACTORS.

John G. Sutton Company has been awarded the electric work for St. Francis School.

The McFell Electric Company have been awarded the electric work on the Insurance Exchange by Willis Polk, architect.

The Standard Electric Construction Company were the lowest bidders on the Starr King School, on the southeast corner of Twenty-fifth and Utah streets. The bids were: Standard, $1924; National Electric Company, $1996; General Electric Construction Company, $2100; John G. Sutton, $2198; Turner Company, $2498.

Bids for the Sacramento Armory were opened and the bidders were: Central Electric Company, $2244; Scott, Lyman & Stack, $1950; Standard Electric Constructiou Company, $1694. The bids were all rejected and the work will be done by day labor. This work has been figured four times and the man who will do the work has never been called on to give a public figure.

Four sets of figures on almost the same set of plans satisfies the writer of the impossibility of the State Engineer's office to do the work as cheap as the lowest bidder has offered to do it.

The Treasury are calling for bids on the new Sub-Treasury biulding. About $500,000 will be spent on same.

A large hotel at Spokane is being figured by a number of local contractors. It has been reported that electrical work will run close to $100,000.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

November 2.

The San Jose Terminal Railway Company filed an amended application for permission to issue $200,000 of 5 per cent bonds for the construction of an electric railway from San Jose to tidewater at Alviso, and the establishment of a boat service between Alviso and San Fraucisco.

The Ojai Power Company applied for a certificate of public convenience and necessity to sell electric power in Nordhoff, Ventura County, and for permission to issue $25,000 of capital stock.

November 4.

The San Joaquin Light & Power Corporation applied for authority to issue $925,000 of bonds to take up and refund notes which the company has given to banks and individuals for money borrowed and used in constructiou work. Permission is desired to issue $320,000 of these bonds at the present time and the balance at a later date.

W. L. Childers applied for authority to lease the Crescent City Water Works and to give an option to purchase to James H. Owen. James H. Owen joined in the application, asking for authority to assign the lease to the Mountain Power Company.

The Railroad Commission issued an amended order correcting a date as to the maturity of bonds previously authorized upon application of the Pacific Electric Company.

November 5.

The Pacific Telephone & Telegraph Company applied for permission to purchase the stock and to take over the properties of the San Gabriel Valley Home Telephone Compauy.

The San Diego Consolidated Gas Company applied for permission to execute a supplemental deed of trust to convey to the trustees, the Harris Trust and Savings Bank and the Los Angeles Trust and Savings Bank, additional properties newly acquired by the corporation.

November 6.

The Commission rendered a decision granting permission to the West Coast Gas, Light & Fuel Company and the Home Gas & Electric Company of Newport Beach, Los Angeles county, to consolidate and to issue new securities. The consolidated corporation, to be known as the West Coast Gas Company, is empowered to issue $91,075 of stock and $100,000 of bonds.

INDUSTRIAL

INCIDENTS IN THE DEVELOPMENT OF CABLE MANUFACTURING.

The first cable of which there is any record was laid at Birmingham, England, in 1837. It was composed of a number of gutta-percha covered wires encased in an iron pipe. Owing to the imperfect protection afforded by the pipe its life was very short.

During the next half-century the problem of an efficient protective outside casing for the wires remained the most difficult one in cable manufacture. The period from 1837 to 1880 was largely one of experiment. Many varieties of telegraph and telephone cables were tried out during that time, but all developed that fatal defect of being non-moisture-proof when laid underground.

In 1880 a cable was finally introduced which attained some measures of success. It consisted of cotton-insulated copper wires bound together and drawn into 200-foot sections of lead pipe; the interior of the cable thus formed was then thoroughly saturated with paraffin throughout its entire length.

It was with one of this type that the Western Electric Company began its manufacture of cable in 1882 and continued with little change until 1891, when paper insulated conductors were introduced. The substitution of paper insulation for that of wool or cotton resulted in such a remarkable improvement in transmission and such a decided reduction in cost, that the paper core cable has almost completely displaced the older types.

Of the four principal manufacturing operations through which cable passes—insulating the copper wires, pairing the insulated wires, winding the wires into a cylindrical core, and sheathing the core—the insulating and sheathing processes only have undergone important changes.

The insulating operation was radically changed when the use of paper was inaugurated a new design of insulating machine becoming necessary. The first method of applying paper insulation was to pull the wire through a die which folded a ribbon of paper lengthwise around the wire. Spirals of different colored threads were then wound around the inslated wire in order to keep the paper binding in place, the various colors serving to distinguish the different pairs of wires. This method is still employed by foreign manufacturers in the insulation of the coarser gauges of wire.

In America, however, it was almost immediately replaced by our present method, in which the paper ribbon is wrapped spirally around the wire; the covered wire being afterward run through a bushing ("polisher") in order to bring it to the required diameter.

The first type of machine used for this purpose was necessarily slow, as the supply of paper that was wound on a comparatively small bobbin could not be revolved about the wire at a very high speed. About 1897, however, a much faster machine was developed. Is this a revolving disk carries a pad of paper tape upon its face. As the disk and the pad revolve together, the paper is unwound at the same rate of speed, regardless of the size of the pad. The design of this machine has been constantly improved until at present the paper insulation can be wound around the wire at the rate of 2800 turns a minute.

The lead sheathing operation was, in the beginning, a very tedious and expensive process. At that time the lead pipe was purchased in approximately 200-foot lengths. Four of these usually constituted a cable length, and were laid out straight on the floor to receive the core. In order to start the cable core through the sheath, a ball attached to a cord was forced through the pipe by means of a hand air pump—something like a bicycle pump. To the cord was attached a rope, by means of which the cable was drawn through.

The men employed to do this kind of work had to be a combination of sailor and plumber, as they had first to pull the core into the lead sheath, and then solder the joints. The plumbing work followed the "drawing-in" operation, the ends of the pipes being brought together and the joints wiped in the regular way, except that the diameter of the joints was made as small as safety would allow.

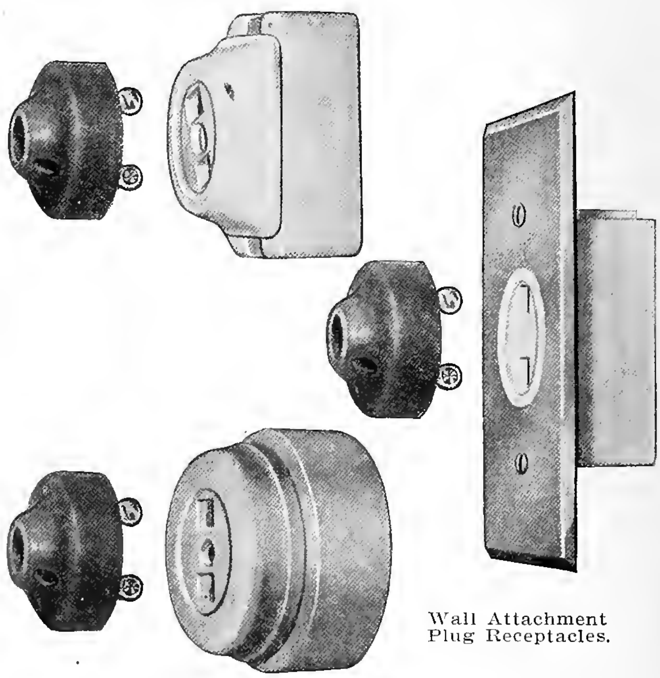
After the sections had been joined the length of sheathed cable was wound on a drum and placed in an oven. Here, by means of a vacuum, melted paraffin was forced through its entire length until the core was saturated. The finished cable was then rewound on wooden reels ready for shipment.

In 1892 this slow and laborious process was replaced through the efforts of W. R. Patterson, of the Western Electric Company. By an ingenious invention, known as the "die block," he made it possible to form a continuous lead sheath around the core as it passed through a chamber filled with plastic lead. This process, which gave the name "Patterson cable" to the product, is, with some improvements in the die blocks and presses, still employed in forming the sheath.

The change to a continuous sheath made it possible to omit the saturation of the core with paraffin, as the cable could be taken direct from an oven and passed through the presses without any danger of its taking up moisture.

NEW CUTLER-HAMMER RECEPTACLES.

The increasing use of household electric heating devices and small motor-driven devices has created a demand for plug receptacles, because it is not always convenient or desirable to feed these devices from the fixture socket. The attachment plug receptacles illustrated below have recently been put on



Wall Attachment Plug Receptacles.

the market by The Cutler-Hammer Manufacturing Company of Milwaukee to fit in with their line of porcelain and composition attachment plugs. The caps for the three styles of receptacles and the attachment plugs are identical, so that where the plugs are already in use the receptacle without the cap can be installed, unless, of course, a separate cap is desired. White porcelain and black composition caps are furnished same as with the attachment plugs.

NEWS NOTES

INCORPORATIONS.

SAN FRANCISCO, CAL.—Olston Electric Stove Company, $25,000, shares $1 each, subscribed $3, by W. F. Cochran, Otto Olston and Jos. Rosenburg, 1 share each.

SALT LAKE, UTAH.—The Interurban Construction Company, which was incorporated under the laws of Maine some time ago, has filed a certified copy of its articles of incorporation. The object of the company is to construct the Salt Lake and Utah Railroad which is to be an interurban line beween Salt Lake City and Layson. The company is capitalized at $1,500,000, and the temporary organization that was formed in Portland, Me., has E. A. Turner of that city for president, F. M. Orem of Salt Lake for treasurer, and Carl W. Smith as additional director.

ILLUMINATION.

LONG BEACH, CAL.—A movement is on foot here to establish a municipal electric lighting system at a cost not to exceed $100,000.

MT. VERNON, WASH.—The Pacific Northwest Traction Company has been awarded the contract for furnishing city light for a period of five years.

MT. VERNON, ORE.—The contract for the city lights has been let to the Pacific Northwest Traction Company to furnish the city with light for five years.

SANTA BARBARA, CAL.—The Reynolds Electric Supply Company has placed an application before the board for a franchise for the Carpinteria lighting system soon to be installed.

LAS VEGAS, NEV.—It has been decided to install 115 eighty-watt tungsten lights in such manner as to light the whole city, according to plans and specifications furnished by the Western Electric Company's expert.

SEATTLE, WASH.—An ordinance has been passed which provides for a $425,000 bond issue, the money to be expended in building an auxiliary steam, light and power plant in the city. The matter will be placed before the voters in the March election.

HILTON, ORE.—An election has been called for December 10 for the purpose of submitting to a vote of the people the proposition of bonding said city for the sum of $18,000 to be expended for the enlargement, extensions and improvement of the city electric lighting system.

SAN JACINTO, CAL.—J. W. Tibbot, G. B. Tibbot and Claude H. Webber have purchased the gas plant of this place. A car load of machinery has been received and is being put in place. Extensions will be made and everything done to give people an efficient and satisfactory gas service.

CHEHALIS, WASH.—A contract has been signed by the Washington Electric Company and the Ostrander Railway & Timber Company, whereby the local concern is to furnish light and power for the city of Ostrander. A substation will be installed in a central location at Ostrander for the distribution of the electric energy.

PORTLAND, ORE.—The Northwestern Electric Company has been granted a franchise for a period of 25 years to enter the local field in competition with the Portland Railway, Light & Power Company. Work on the White Salmon, Wash., power plant will be rushed to completion, as will the business pertaining to the terms of the franchise.

PORT ANGELES, WASH.—The new dam of the Olympic Power Company on the Elwah River has been washed out. A portion of the Port Crescent road was destroyed and the county bridge is a total loss. The dam with its mechanical equipment represents $500,000. Allen E. Ransom, assistant superintendent of the company, states that work of repairing the damage will be begun immediately.

EL PASO, TEX.—The Texas Light & Power Company, an east Texas and New York syndicate, has obtained control of the El Paso Gas & Electric Company from the Chicago company, which owned it. It is reported that the same company has filed a chattel mortgage to the Bankers' Trust Company of New York, as trustee, for $30,000,000, for the purpose of extending and improving its plants.

SAN DIEGO, CAL.—Notice is given to all stockholders of the San Diego Consolidated Gas & Electric Company that the board of directors has adopted a resolution to hold a meeting on December 23, for the purpose of considering and acting on the proposition that the company increase its bonded indebtedness not exceeding $3,000,000, said bonds to be issued for the purpose of discharging floating indebtedness of corporation; bonds payable not later than December, 1922, bearing interest at rate not to exceed 6 per cent per annum.

TRANSMISSION.

SILVER CITY, N. M.—The Water & Electric Light Company is surveying a line to connect its power house with the 85th mine. All power used at the mine will be supplied by this company.

CORONA, CAL.—The Consolidated Reservoir and Power Company hereby levies an assessment upon its capital stock to the amount of $5.00 per share, for the purpose of extending its pipe lines to the Barker lands.

REDMOND, ORE.—At a special meeting of the city council a franchise was granted to Geo. Jacobs of Portland, for an electric light and power plant in Redmond, same to be constructed and in operation within 60 days. The new plant will furnish a 24 hour service.

DOUGLASS, ARIZ.—The Douglass Traction & Light Company has a force of men at work constructing a high tension lead to connect with the Copper Queen smelter. This will act as a safeguard guaranteeing a supply of electricity should the city plant break down at any time.

LOS ANGELES, CAL.—Notice is hereby given the Citizens Trust & Savings Bank, successor to the interests of the Broadway Bank & Trust Company, that bonds of the Salinas Water, Light & Power Company were called for payment November 4. Upon presentation of said bonds and surrender thereof the premium provided in the deed of trust, and par value will be paid the owner.

PHOENIX, ARIZ.—The Corporation Commission, after reconsideration on the application of the Williams Electric Light & Power Company, at Williams, has decided to allow the new concern to take over the assets and will issue an order to that effect in a few days. The hearings in the Williams matter, however, are not yet completed. The Williams company has also an application for permission to place $250,000 bonds on the market for the purpose of constructing improvements of the present plant.

RANDSBURG, CAL.—Work on the high power line of the Southern Sierras Power Company is being pushed rapidly and will be completed to Bishop in Inyo County soon. Officials of the company state that the line will be completed for the delivery of juice from the Inyo power house by the first of the coming year. The lines were held up by right-of-way troubles in the aqueduct district for some time, causing a long delay, but that has long since been settled and for some time the work has been ropidly pushed. In San Bernardino and Riverside counties 175 miles of distributing lines were built at an average cost of $1000 a mile. More than 75 pumping plants have been connected up and others are being supplied as fast as possible. The telephone line running parallel with the power line from San Bernardino to Bishop and connecting Randsburg with coast points was finished to Bishop last week. The substation east of town is completed and ready for service.

TRANSPORTATION.

EUGENE, ORE.—The Oregon Electric Railway Company will erect a $20,000 passenger depot here.

VICTORIA, B. C.—Residents of Bay street have petitioned the B. C. Electric Company for an extension of the line into their territory.

EUGENE, ORE.—It is rumored in this city that the Oregon Electric Company will extend its line from Eugene to R sebürg, work to be begun in the spring.

NORTH BEND, ORE.—F. L. Sturm, a North Dakota capitalist, is looking over the territory in this section with a view of establishing a street car system between this city and Marshfield.

NEW WESTMINSTER, B. C.—The B. C. Electric Railway Company may build a line from this city to Port Moody. The Board of Trade and Progress Association are back of the movement.

CENTRALIA, WASH.—The Washington Electric Company, which proposes to construct a line from Vancouver, Wash., to Tacoma, has applied for a franchise to operate through this city.

EUGENE, ORE.—The Oregon Electric Railway Company will have a complete car repairing plant in Eugene, the contract having been let in Portland to La Deaux & La Deaux of that city for the erection of the building.

LOS ANGELES, CAL.—Detailed plans are being prepared in the architectural department of the Pacific Electric Railway Company, for the new terminal station at Sixth and Los Angeles streets, to be of brick construction.

BOISE, IDAHO.—The Idaho Traction Company has been granted permission to lay tracks on certain streets of this city. The company named has also applied for a permit to construct three sidings on city streets for passage of cars.

CENTRALIA, WASH—The Washington Electric Company, recently incorporated under the laws of Oregon for the purpose of constructing an electric line through Centralia from Vancouver to Tacoma, has secured an option on the old grade and right of way of the T. O. C. V. Railway. It is reported that work on the new line would begin about November 15.

PORTLAND, ORE.—In carrying out its plan for the electrification of the Willamette Valley and the establishment of a suburban service of the utmost importance to Portland business interests, the Portland, Eugene & Eastern Railway Company, has purchased from the Portland, Railway, Light & Power Company the nine-mile stretch of railway track known as the Willamette Falls Railway, and in part will utilize the old road as a portion of the new main line from Portland to Salem.

SACRAMENTO, CAL.—Changes have been made in the schedules of the Central California Traction Company, running between this city and Stockton, so that better connections can be made with Santa Fe passenger trains at Stockton. The schedule change follows an order of the State Railroad Commission directing the Santa Fe to grant through joint rates in connection with the electric line. The train that now leaves here at 2:15 p. m. will hereafter depart at 2:10 in the afternoon; the train that formerly left at 6 p. m. will not leave until 6:20 p. m. under the new schedule, and the train which now leaves at 10:10 p. m. will leave at 9 p. m. Of the trains coming to Sacramento from Stockton and Lodi, that which now gets here at 8:30 a. m. will arrive at 7:45 a. m.; that which now arrives at 9:42 p. m. will reach here at 10:20 p. m., leaving Stockton at 8:30 p. m. instead of 8 p. m. Mandatory through rates between the Traction and the Santa Fe became effective on October 10.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has filed its application for a franchise for operating over the tracks of the proposed municipal railway on San Pedro street from Aliso to Ninth streets. The application contains a clause covering the use of Los Angeles street in case the Pacific Electric is forced to vacate San Pedro street. The application was referred to the board of public utilities to report back to the Council. The utilities board will approve the notice of sale of this franchise and return it, with the board's report on the franchise application, when the council will authorize the publication of notice of sale of the franchise, according to the prearranged plan. This arrangement is the result of the final compromise on the long-drawn-out San Pedro street franchise question and the plan to relieve Main street traffic congestion. According to the compromise the Pacific Electric is to bid for the contract to build the line as a part of the municipal railway to the harbor. The company will take a revocable franchise to use the tracks from Aliso to 9th streets, with the condition that if the franchise on San Pedro street is revoked inside seven years the company will go on Los Angeles street with a total tenure of not more than ten years on the two streets, in case the city wishes to take over the line.

TELEPHONE AND TELEGRAPH.

POMEROY, WASH.—The telephone company contemplates stringing more cable and providing for larger phone facilities.

RAVALLI, MONT.—Telephone connections between this place and Polson will be established by the Mountain States Telephone & Telegraph Company.

ENTERPRISE, ORE.—The Home Telephone Company intends to improve its lines in Wallowa county. Work on the line between this city and Joseph will start at once.

MARTINEZ, CAL.—The Pacific States Telephone & Telegraph Company is arranging to build a telephone line from Suisun to Grizzly Island, a distance of about 15 miles.

SEATTLE, WASH.—The proposition of issuing bonds for the establishment of a municipal telephone system will be placed before the voters at the general election, March 4.

PT. ORCHARD, ORE.—Ellis Bros. have been awarded the contract for furnishing telephone poles and installing same for the Six Elk Telephone Company from this city to the Elk River.

EL PASO, TEXAS.—Long distance telephone wires for the new route from El Paso to Las Cruces already reach Anthony, N. M. The new line will be five circuit and ten wires, and is being strung from El Paso to the New Mexico state line by the Tri-State company and from that point on to Las Cruces by the Mountain States company.

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POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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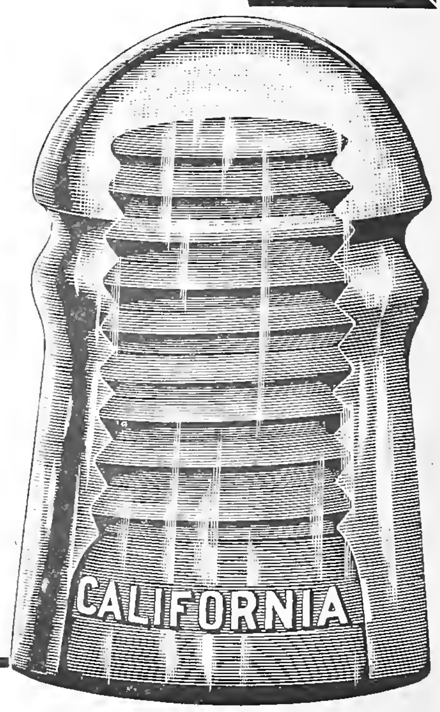
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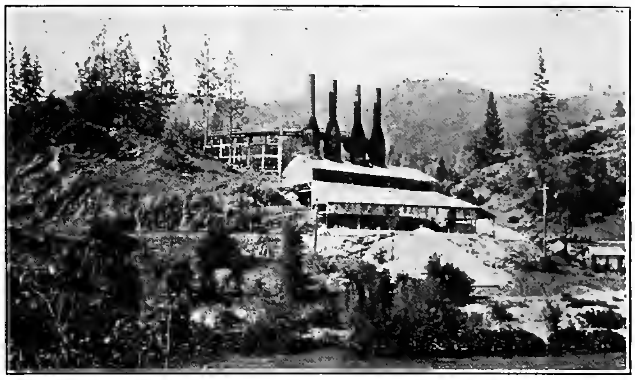


General View of Smelting Plant from Across the Pitt River. Incline Tramway in Left Background. Smelter Building in the Center Foreground; Lime Kilns at the Right.

ELECTRIC IRON SMELTER AT HEROULT ON THE PITT

BY RUDOLPH W. VAN NORDEN.
Member A. I. E. E., A. S. C. E.

About six years ago birth was given to a new child of California's industrial production, new only to California, but otherwise old almost as man himself. But it was different, far different from the world-old production in every other part of the earth. This perhaps is the reason it was new to California. California has almost everything, not excepting great deposits of iron ore. All of the pig iron used in this state has, however, come from the East, or from China, or in any event somewhere outside its limits. And this has been due to two reasons, inaccessibility and the high cost of fuel, so that the product which might have been made easily enough, could not have competed with pig iron brought into San Francisco and other ports in ballast. But California is blessed with many great water powers and the electrical energy generated therefrom can be taken almost anywhere.

A group of men headed by H. H. Noble, president of the Northern California Power Company, forseeing the great future possibilities of a market for pig iron which could compete with the imported product, conceived what has proven to be one of the nerviest projects which has ever been fostered in California. And the Noble Steel Company was the result of their determination to discover a method of converting the energy of the electric current into heat for the reduction of the unusually rich iron ores which they had acquired, at a cost to make this production commercially possible. The story of the development of this smelter, the heartbreaking trials, costly delays, unforseen misfortunes, repeated failures, always bolstered up and ready to go at it again by the indomitable courage and unswerving faith of these men, held together and helped and reassured through the untiring energy of their leader, will add a chapter to the glorious history of California, which, next to the satisfaction of the success which it will chronicle, will be a fitting tribute to the genius of faith and daring.

Electric furnaces of various kinds, mostly experimental, were in existence at the time this project was commenced. Induction furnaces were in use for converting iron into steel, and a number of inventors, mostly in Europe, had devised furnaces using an electric arc as a heating element. In most cases these were cumbersome and impractical.

In 1904, Dr. P. Heroult, a Frenchman by birth, took out patents in several countries on a single-phase arc furnace. One of these was built and put into experimental use at Sault Ste Marie, Ontario, and seemed to have promise of successfully solving the problem of smelting iron ores.

In 1906, Mr. Noble, after making a study of the various processes, arranged with Dr. Heroult to proceed with the erection of a furnace of this type. The quarry was opened, a narrow gauge railway and an inclined tramway were built. A charcoal oven on a small scale was erected and little by little an experimental plant was developed.

This Heroult furnace was built to use three electrodes and three-phase current supply instead of the single-phase type of the earlier experiments, and it was hoped to be able to commence on a small scale,

on its completion, the production of pig iron and thereby show that such production with the electric current was commercially possible. While a small amount of pig iron was produced which was encouraging, commercially the furnace was a failure, but was afterwards used to produce ferro-silicon. This latter material is used in the ordinary open-hearth furnace process and for a time it was produced at Heroult as a commodity.

After many trials it was decided to build a single-phase furnace, using two electrodes. This furnace went into the scrap heap. Another furnace expert came upon the scene and a new single-phase furnace was evolved, this time employing six electrodes.

The story of the ups and downs, and bright prospects soon shattered, is too long to recount here. The fourth furnace demonstrated the feasibility of electric smelting, but was mechanically weak, and then the fifth furnace was built and abandoned, the latter a very costly and intricate mechanism, was scarcely tried out before it proved an utter failure. And then came the sixth. This is more nearly like the original Heroult furnace than the others, although the resemblance is only general. It is simple, absurdly so, and one wonders that it was not thought of the first thing. And yet it is different from any furnace in existence. The wisdom of old furnace men, experts who understood the smelting of iron ore using fuel for heat, seemed to have failed. The new furnace seems to have been a final effort to gather together into a tangible whole, the ideas of those who were carrying out this work, but much of the credit must be given to R. E. Frickey, the electrical engineer who had charge of installing the furnace.

Does it really smelt? Does the iron run out when you want it to as those who claim to know say it does? Are they actually using electric power or is fuel being surreptitiously used? Can it be produced commercially? These questions have been asked for the thousandth time, not only in California, but all over the world. And the answer to all is: The furnace is running every day; there has been no interruption from any cause since September 5th; three times every day, at regular intervals, six tons of the highest grade soft pig iron is tapped from it. The electric furnace is an assured fact, a commercially successful machine, the forerunner of a great new industry, an untold potential wealth to add to California's greatness.

General Plan of Plant.

The location of the plant was determined largely by the location of the natural resources, iron ore, limestone, wood for fuel and the availability of low-priced electric power.

It is situated on the north bank of the Pitt River in Shasta County, at a point about one and one-half miles above the junction of the McCloud River with the Pitt, and about six miles above the confluence of the Pitt and the Sacramento rivers.

While the plant is not on the main line of the railroad, which winds its way through the Sacramento canyon, it is reached by a standard gauge branch road, known as the Sacramento Valley and Eastern, and rail shipments may therefore be directly made from the works.

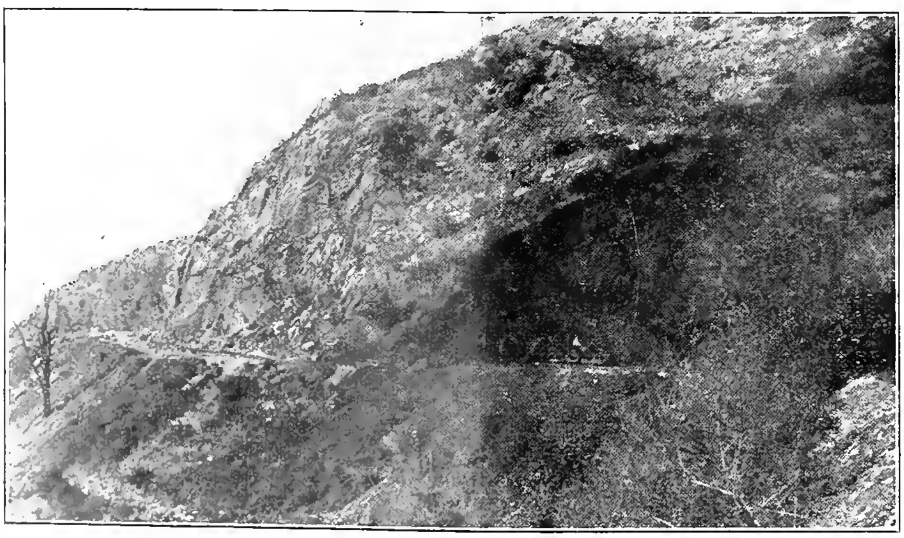
The surrounding country is rugged, composed of irregular mountain ranges and deep valleys, heavily mineralized, partially timbered, dense masses of brush growth and altogether picturesque.

The plant proper covers an area of about 10 acres, extending along the Pitt River a distance of half a mile. It is necessarily built on a side hill slope, as the banks of the river rise from its surface on a heavy grade, which forms the ridge between the Pitt and the McCloud watershed.

In the layout of this plant, it must be borne in mind that this enterprise has, until a recent date, been of an experimental nature. Many of the devices for handling the raw materials and for the various processes were originally installed for operating on a small scale, sufficient for the development of a new process, and, except in a general way, the ultimate layout was a matter to be determined by the final results and the hoped-for success of the enterprise.

For this reason, it was not advisable to expend any more money on plant equipment than was absolutely necessary for the purpose in hand. Furthermore, much of the plant, due to the fact that there was little or no precedent to follow, was the result of inventive genius, fulfilling the needs which seemed apparent.

In any case, the problem originally presented the



General View of Quarries. The Lime Deposit Is at the Left and the Iron Ore Is Seen at the Right, Where the Men Are at Work.

handling or manipulation of five cardinal parts. There were the iron ore and limestone quarries to be opened; a method of transportation of sufficient raw material for experimental purposes; a means of getting charcoal for the furnaces; a means of getting lime also for the furnaces; and a suitable electrical installation delivering low voltage alternating current upon which the entire enterprise is based. In addition to this, a certain amount of income was available from the sale of by-products condensed from the fumes of the charcoal ovens, which would assist in compensating for the cost outlay of the work. There was also necessary substantial buildings,. houses for employees, a water system, etc.

As the work has proceeded, these various parts have been replaced or improved, and as the success of the project has become manifest, many valuable and permanent improvements have either been made or are contemplated.

The Quarries.

In nature it sometimes seems that aside from forming the raw materials, they have been so arranged to assist man in perfecting its works. At Heroult a remarkable condition of this sort is manifest. High up on the mountain back of the plant, extending from an unknown depth in an almost vertical ledge to its summit, is a deposit of magnetite iron ore, probably as rich as may be found anywhere an earth.

This ore has a percentage of 70 in metallic iron. It is dark red, shading to a blue black in color, and is, of course, very heavy. It is easily worked and can almost be drilled, as it is so soft. The face of this ledge, which has been opened, is 90 feet wide and about 50 feet high. It may be seen in the view, the dark space at the right, before which a gang of laborers are working. Many test holes have been driven into the mountain at various levels to determine the extent of this ledge. The line of fault can be readily followed up the hill to the summit, and to all appearances the ore body is of great extent, sufficient to supply the needs of the smelter for an indefinite period. The deposit of limestone, which is necessary in making a flux for the molten bath in the smelter,adjoins the iron ore deposit. In fact, the fault which marks the limit of the iron ore body is also the dividing line between that body and the limestone ledge. There is much limestone in this country, which may be readily seen from the appearance of the adjoining peaks and ridges, the white crystalline nature of the rock giving much of the prevailing color effect.

These quarries being side by side, an extension of the tramway from the ore quarry was all that was necessary to obtain transportation for the limestone. The high face of the limestone quarry may be seen just beyond the face of the ore deposit in the picture of the quarries. The limestone is crystalline in nature and light in color. The finer-grained stone is superior for lime-making in the type of kiln used, as it will not disintegrate so readily after it is burned. As much of the rock is coarse, some care must be expended in the selection for use in the kilns.

For the present the quarries are worked by hand, but the time is not far distant when power in various forms will be needed in order to economically excavate the ore and rock necessary to supply the smelter.

The quarries are on the McCloud River side of the ridge, at an elevation above the works of about 600 feet. A two-foot gauge track is laid from the quarry faces on a grade sufficient to cause loaded ore cars to run by gravity, along the hillside, through a cut in a saddle of the ridge, and then along the contour of the mountain on the Pitt River side, a distance of one and a quarter miles to a point directly above the smelter. Here the track is carried onto a trestle which termintes in a head house. The empty cars are hauled back to the quarries by mules.

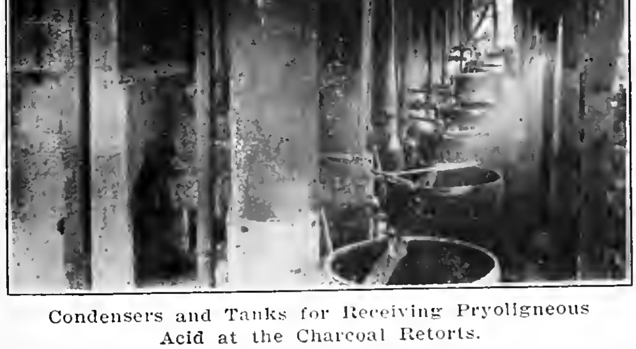
The inclined tramway, 1800 ft. long, which is 24 in. gauge, is laid on a tangent from the head house to the bottom of the incline. This has a maximum grade of 37 per cent.

From the bottom of the inclined tramway, the cars are switched over several lines of track to their destinations at the smelter or the limekiln, being hauled by mules.

At the works proper there are six main buildings—the boiler house, where steam for various uses is generated; the charcoal ovens or retorts; the refinery, where the by-products from the manufacture of charcoal are distilled and collected; the substation, which contains the lowering transformers, receiving current from the power transmission lines and delivering current at 2400 volts for all uses about the plant; the foundry building, which contains the electric furnaces, and which is the principal point of interest in the plant; and, finally, the limekilns.

The boiler house is a corrugated iron building, containing two Westinghouse, Church, Kerr return tube boilers, each rated at 100 h.p. These boilers use crude oil fuel, and have the regular complement of burners and oil feed pumps. There is also a Goulds 3-throw plunger pump, driven by a 30 h.p Westinghouse induction motor. This is installed for fire purposes and to augment the regular gravity service supply.

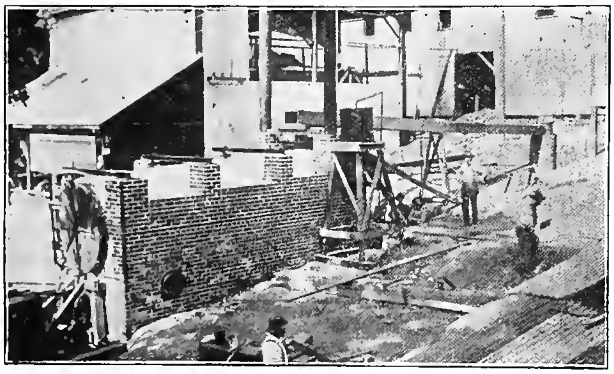
In the manufacture of iron, charcoal as carbon is necessary for the proper chemical reaction, whether the smelting is done by the ordinary processes, using fuel for heat, or by the electric process. Other forms of carbon, such as coke, may be used, but the charcoal, in this case at least, gives the most satisfactory product. The amount of charcoal needed equals in weight about one-fourth to one-third of the ore charge. It can readily be seen that a very large quantity of charcoal is thus consumed. Cordwood, from which the charcoal is made, is costly, no matter how easily it



Condensers and Tanks for Receiving Pryoligneous Acid at the Charcoal Retorts.

may be obtained, and together with the cost of fuel, attendance and the interest on the plant investment, represents a large part of the cost of the final product. The theory of making charcoal is simple; it consists of enclosing the wood in an air-tight chamber to prevent combustion, and then bringing the wood to a high temperature, thus driving off all volatile substances in which wood is rich, leaving the charcoal, which is practically pure carbon. As a great quantity must be in the making at any one time, the necessary plant is large. The by-products, which in the old-fashioned methods of charcoal manufacture were allowed to escape into the atmosphere in the form of smoke, are in themselves as valuable as the charcoal, and by saving them a large source of income may be derived.

The type of plant which has been in use here consists of a battery of eight retorts, each being a vertical cylinder six feet in diameter and sixteen feet high. In the bottom of the retort is a hopper, in which the fumes driven from the wood are led into a condenser, and the liquid thus received, known as pyroligneous acid, is gathered into wooden tanks to be later distilled and refined into its various constituents. The retorts are



"Yost" Charcoal Retort in Foreground. Boiler House Left Background and Refinery House Right Background.

mounted in a heavy concrete structure. Below them and to one side are the furnaces, one for each retort. These burn fuel oil. The carbon monoxide and other inflammable gases of the by-products are led through 3-inch pipes into the furnaces, to be consumed and assist the oil fire. The cordwood charge is loaded into a cylindrical container five feet in diameter and sixteen feet high.

Seventeen hours' firing is required to complete the charring process. The container is then hoisted out of the retort and taken to the cooling frame, this being necessary, as the contents are red hot. The cooling frame consists of seven steel drums placed in the arc of a circle, in which the loading crane is at the center. These drums contain water, and the container is lowered into the drum, the water coming far enough up the side of the container to form a water seal and prevent air from getting into the hot charcoal, thereby setting it on fire. Streams of water are now played on the sides of the container and continued for twelve hours, until the charcoal has become cool. The container is then raised and moved over the opening in the top of the storage bin, and the charcoal is dumped into it. The view shows three of the containers standing in their water seal, while one is hanging above the bin and is about to be dumped.

This description has been given as it is a method of making charcoal in wide use, especially in the Southern States. While a good part of the by-products are saved in this process, there is enough loss to justify the abandonment of this plant in favor of a newer system in which the added saving of by-products will soon pay for the cost of the change.

The Yost Charcoal System.

There are now in process of construction twenty retorts of the Yost system. An experimental retort was recently erected and tried out, with the result that it has been adopted. This retort consists of a steel cylinder five and one-half feet in diameter and twenty feet long. It is mounted horizontally in a brickwork enclosure. One end is closed, while the other is provided with doors. A track is led into the retort, and a car loaded with cordwood is run into the retort, which is then closed and sealed. The volatile by-products are led through a copper pipe fourteen inches in diameter, which tapers to six inches, to a near-by condenser, while the liquid tar is drained from the bottom into a tank. The furnace is fired with crude oil by the hot-plate system, oil and water are dropped in a fine stream on to a hot plate within the furnace, where it instantly spreads and volatilizes. This type of retort is much less costly, due to its simplicity, than the older type, and does away with much of the handling formerly necessary. Practically all of the by-products are saved. The condensers consist of vertical steel drums about two feet in diameter and ten feet high; they contain pipes through which the gases are taken. Water surrounding the pipes acts as the condensing medium.

The refinery building is of corrugated iron, two stories in height. The pyroligneous acid is pumped from the several wooden tanks adjacent to the retorts into a 5000-gallon rectangular concrete tank. From this receiving tank it is pumped to the various stills as needed. Steam is supplied for heating the pyroligneous acid preparatory to distillation. There are two 1650-gallon copper stills, from which the various ingredients, wood alcohol, acetic acid, wood oil, turpentine, creosote and finally acetate of lime are taken. An alcohol still of 1700 gallons further purifies and delivers into a large tank the wood alcohol for commercial use. There is an acetic acid still of earthenware, with coil of the same material, which has a capacity of 500 gallons. Two rectangular tanks five feet by eight feet, for the production of acetate of lime, which is the final product after all other ingredients have been removed, are also used for the creosote treatment of timbers, this liquid being led into these tanks. These are superimposed on steel tanks containing steam coils for heating the creosote.

With the installation of twenty Yost charcoal retorts, which are to be placed on land east of the present plant, on a fairly flat stretch of ground, and which are now under process of construction, the refinery building will be moved to this new site and enlarged to handle the increased supply of by-product.

Limekiln.

A short distance east of the smelter building and close to the railroad track is the limekiln installation. This consists of a battery of four 7½-ton capacity

kilns, built by the Mutual Engineering Company of San Francisco. These kilns are of the continuous type, in which oil is burned for fuel, and they are drawn down once every three hours. Fuel oil is run from cars into a sump below the track, and it is pumped from the sump by means of a 5-throw Seneca Falls pump, driven by a 5 h.p. induction motor, into a tank. There are two Cornish "low-down" marine boilers, which supply steam at 30 pounds pressure for the burners. The oil for the feed is pumped by Worthington duplex steam pumps.

The lime produced is not only used in the production of iron, but is is also shipped as a commercial commodity.

The water supply for all uses about the plant is from the Pitt River, and is pumped into two tanks. The pumps are in duplicate to insure a continuous service; they are mounted on an incline structure, which permits the raising or lowering of the pump units to accommodate the water level in the river. These units are 6-in., 2-stage, Byron Jackson centrifugal pumps, direct connected, and driven by 50 h.p. induction motors. There are two service tanks at different altitudes, the water being delivered into the upper of these, which is 174 feet above the river at low water. This tank is of timber staves, 15 feet high, and has a capacity of 25,000 gallons. The lower tank is at an elevation of 119 feet, is 16 feet high, and has a capacity of 50,000 gallons. The upper tank is used directly for domestic and fire service, while the lower one is to supply water for the furnaces and retorts.

Transformer Substation.

A new transformer house of sufficient capacity to supply current to the furnace equipment, which is now under construction and contemplated, is of corrugated iron and adjoins the furnace building. It is 20 feet wide, and 50 feet long, and is equipped with a 10-ton hand-operated traveling crane, with triplex chain block. There are six Westinghouse 1500 kw. oil-immersed and water-cooled lowering transformers, wound for a voltage ratio of 38,100 to 2400, to be Y-connected on the high-tension side for 60,000 volts supply. A two-panel distributing switchboard and oil circuit breakers occupy one end of the building. In an "L" a set of electrolytic aluminum cell lightning arresters and two sets of 60,000-volt oil circuit breakers with inverse time limit automatic control completes the substation equipment.

Heretofore the plant has received its electrical supply from a substation in a small brick building east of the smelter building. This contained three 750 kw. Stanley-G. I., 22,000-19,000 to 2200 volt oil immersed and water-cooled transformers, delta connected to a 22,000-volt supply circuit. Three 50 kw. transformers with ratio of 2200 to 220 volts are used for lighting and power about the plant. With the change of the transmission line voltage from 22,000 to 60,000 volts, the old substation has been abandoned.

Fuel.

Oil for fuel at various points about the plant, except for the limekilns, is run from tank cars into a steel sump tank close to the boiler house. From this tank it is pumped as needed.

The Electric Smelter.

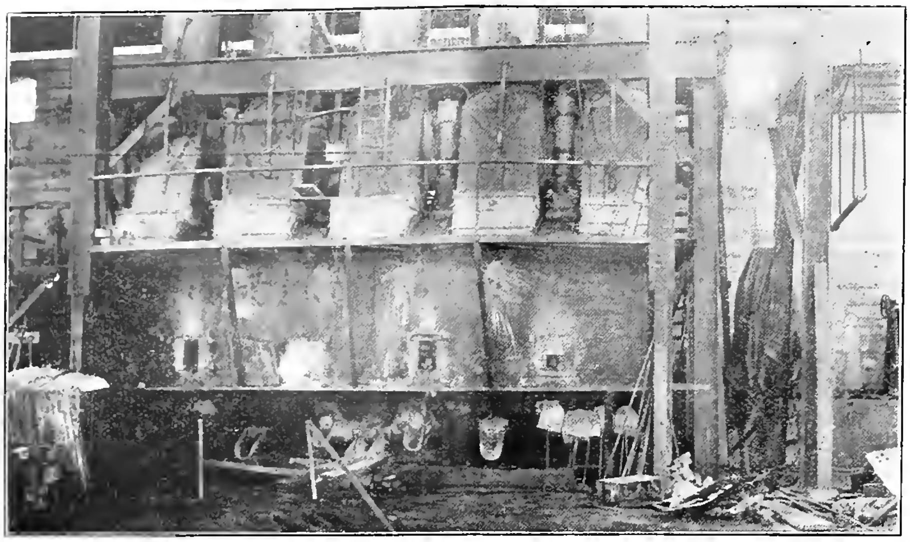
Something has already been said of the remarkable history which has been created by the many experiments, the failures and the final successful outcome

View of Copper Stills in the Refinery at the Left. Cooling Charcoal Containers and Discharging Charcoal Into Storage Bin on the Right.

of a means to smelt iron ores commercially with the heat generated by a three-phase alternating current electric arc. There are in existence several types of electric furnace, none of which were found suitable for this work. The present furnace is known as No. 6, and in its number is an eloquent testimonial of the devious types and forms through which the experiments have been carried to the final perfected design

The furnace building has a heavy steel frame, and is covered with galvanized corrugated iron. It is rectangular in shape, 120 feet long and 75 feet wide, and has a height of about 60 feet. Its position is parallel to and adjoining the railroad track. The 24-inch gauge track system of the plant has a track running through the building, with the necessary switches, turntables, etc. The building is in two sections or bays, divided by a line of columns. The more southerly of these is the pouring floor, on which the pigs are cast. Throughout this bay is operated a 50-foot Northern Engineering Company traveling crane. This is electrically operated and has two hoists, one of twenty and the other of five-ton capacity. A Cleveland Electric Controller and Manufacturing Company lifting magnet, having a capacity of 2000 pounds, is used in picking up the pigs. This magnet will lift about 1000 pounds of hot pigs.

The bay to the north of the center columns is given to the electric furnaces, their transformers and the necessary control. The furnaces, of which one has been in continuous and uninterrupted operation for the past two and one-half months, are placed in a line parallel to the length of the building, and are set so that their front side is even with the center line of columns. While but one furnace having a capacity of eighteen tons of pig iron per twenty-four hours is at present in use, two more of slightly greater capacity are practically completed. There is space reserved and it is intended to immediately construct three more, bringing the total number of furnaces in this building to six.



Front View of the Electric Furnace No. 6. Furnace No. 7 Under Construction at Right.

Like many successful devices which have passed through a tedious and intricate period of experimentation, this furnace is very simple. It is all contained in a steel box 27 feet long, 13 feet wide and 12 feet high. The upper half of the box is rectangular, but in the lower half the sides taper toward the center of the foundation. The box is lined with fire clay brick, on the vertical sides, the hearth of the same material slopes slightly from the ends toward the middle, to facilitate the flow of the molten bath, when the furnace is tapped. The tap hole is at the middle in front, and is ordinarily plugged with fire clay until it is time to tap. The roof of the furnace is arched, and has five stacks in a row. In the four spaces between the stacks at the center of the dividing arches are inserted the graphite electrodes, which are fed downard with the aid of jack-screws. Both the electrodes and the arched roof are water-cooled, this feature being essential to successful operation. The stacks or tubes, which are twenty-four inches in diameter, and which project upward from the roof a distance of fifteen feet, are not stacks in the ordinary sense, as there is no smoke or products of combustion given off, as would be the case in a fuel furnace. A small amount of combustible gases not consumed in the furnace is led away to a receiver and will be used in the firing of the charcoal retorts. Beyond this the stacks are used only for the purpose of charging the furnace. A charging platform is built along the top of the stacks and carries a track which runs to the mixing platform. Dump cars with the charge are run on the charging platform and dumped directly into the stacks. Except when receiving a charge, the stacks are closed with a tight-fitting cap.

In the rear of each furnace, and as close thereto as is possible, are the three service transformers, which supply three-phase current at from forty to eighty volts to the electrodes. These transformers are oil-immersed and water-cooled, have a capacity each of 750 kw. The low-tension connections to the electrodes consist of eight pieces of flat copper bar, three-eighths of an inch thick, and five inches wide, bolted together. On the 2400-volt primary side, there are brought out eight current taps for voltage regulation. These are taken to an oil-immersed, individual solenoid-operated switch group, which, with anto-transformer compensator, gives fifteen steps for voltage variation.

The electrodes are made of compressed graphitic carbon; they are cylindrical in form, twelve inches in diameter, and four feet long. The upper end has a tapered male-threaded nipple, while the lower end has a corresponding socket with a female thread. As the electrode is fed into the charge a new one may be fastened to it, making a continuous feed.

An electrode lasts in continuous operation thirty days. Occasionally an electrode breaks in the furnace. At first the detection of a break appeared to be a serious matter, but an extremely simple means of finding this out was evolved. A bar is driven into the furnace opposite the electrode, through one of the several peep holes, and at the same time the electrode is tapped on top with a hammer. The man on the bar simply listens for the tapping. The tapping is then done on the bar and the man on top listens. A break may be accurately located in this manner.

Electric control is through a switchboard, there being a panel for each furnace. As the current and power factor in each phase must be under observation at all times during operation, separate meters are installed in each phase. The requirement for one panel are three ammeters, three voltmeters, three wattmeters, three power factor meters and three recording wattmeters. These are mounted across the panel in rows of three each. Under the first four sets named are three hand wheels to control the voltage variation, and under these three switches, which control the entire load, and still under these are the recording wattmeters.

For operating the voltage control and the main circuit breakers there is a 7½ kw. motor-generator set, comprising a 125-volt d.c. generator, direct connected to a 10 h.p. induction motor. This set has a small panel board mounting a circuit breaker, ammeter, voltmeter, and two single pole knife switches. The transformers, switches and control were supplied by the General Electric Company. In the event that line voltage should fall, or for any other cause, the direct current supply should become deranged there is a National Storage Battery Company's set, having a ca-

pacity of 7½ kw., which may be instantly switched in, and thus prevents the furnace from cutting out in the case of low voltage.

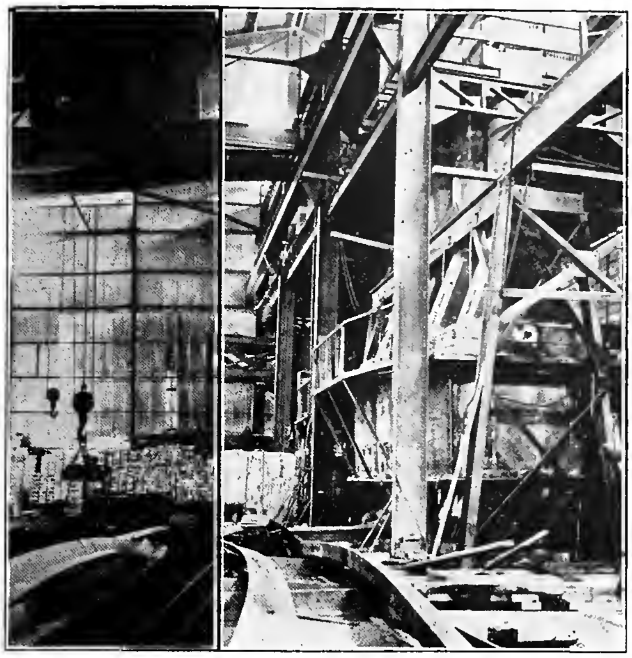
Operation.

In operation the electric furnace is so different from the ordinary blast furnace, and there are so many unheard-of or unlooked-for effects, that the old experienced furnace man, who knows by the sound or by the appearance or by any of the mysterious signs which he alone understands, the condition of the furnace or the condition of the charge, would be helpless should he attempt to operate the electric arc furnace. So far as sound or visible manifestation is concerned, one might stand beside it and not know whether it were cold or whether the bath were ready to discharge its six tons of molten metal over which was being dissipated in the terrific heat of 4200 degrees Fahrenheit the 3000 horsepower of electric energy. There is scarcely a sound. On the charging floor it is different, as considerable heat escapes there, and while a charge is being loaded into the furnace there is ample manifestation of the internal activity.

The furnace operates in a partial vacuum; that is, no air is allowed to get inside. The electric arc travels between the electrodes, which are buried in the charge, and supplies the heat for smelting. The oxygen of the iron ore combines with the carbon, forming not only carbon dioxide, but also carbon monoxide, and many of the higher series of hydro-carbons. In fact, the furnace may be tapped at certain points and draw off one or the other of these gases.

In operation the furnace is continuous. After a period of eight hours the hearth contains a full bath of molten metal, and this is therefore tapped three times each day. Charging is done at regular intervals, and the current is not shut off at any time. When the time for tapping arrives, the pig moulds having been built up in the interim after the previous charge, the furnaceman simply drives a bar through the tap hole and the iron comes out. At first the iron with most of the impurities, particularly the silicon content, comes. This is manifested by the brilliant, but short-lived, display of scintillating sparks; then comes a steady flow of the highest grade, soft, even-grained pig iron that can be produced. After the iron has all run out, the slag follows, and is diverted into the proper channel. In fifteen minutes the heat is over, the tap hole is plugged, and a new bath is in progress of smelting.

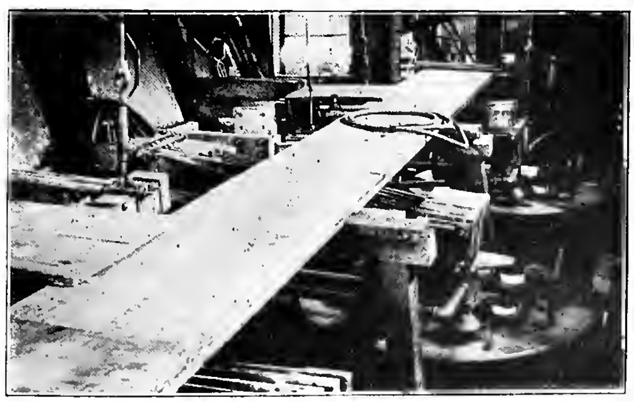
During the period of smelting the change in electrical conditions is interesting. At the beginning of the charge the power factor is almost unity. This gradually lowers as smelting continues, until with a full bath of metal a power factor of about 65 per cent is reached. If coke is used in place of charcoal, or if a mixture is employed a different set of power factor conditions exists. By studying these conditions, it is possible to know the exact condition of the charge by looking at the meters. The load is, of course, a function of the voltage, and with half voltage the load will drop to one-quarter. The consumption of the electrodes constitutes a heavy charge against production. It is offset, however, by the much greater life of the furnace lining than in the case with gas or oil fuel furnaces.



General View in Smelter Building. The Electric Furnace Is on the Right. A Portion of the Casting Floor, Crane and Lifting Magnet, on the Left.

In charging, the ore cars are run on the mixing floor, which is at the same level as the charging floor. Cars with charcoal come into the lower part of the building and are hoisted on an electrically operated elevator to the mixing floor. Lime and quartz for flux are also brought in in cars, and each material is dumped into bins. The mixing is done in a car which is run on a platform scales. The charge is placed in layers, the proportions depending upon the tests made in the laboratory by the chemist. Following is a representative charge:

500 pounds iron ore (Magnetite).
135 to 150 pounds charcoal.
3½ pounds lime (well burned).
12½ pounds quartz.



Tansformers in Rear of Furnace Showing a Set of Secondary Conductors.

Smelting by the equipment installed is in daily operation, and the completion in the near future of additional furnaces, the new Yost charcoal plant, and the added plant equipment for handling a much greater output, will make the supply of pig iron in California an important addition to the great natural resources of which the state is so highly favored.

READINESS TO SERVE METHODS

INTRODUCTION—SUMMARY AND EXPLANATORY.

BY R. B. MATEER.

Articles descriptive of electrical progress since 1882, when the first central station of 250 lamps was placed in operation at Appleton, Wisconsin, give the number of generating stations as now exceeding 8000, and some possessing individual capacity in excess of 100,000 kw., all the result of electrical activity and the progressive methods of those shaping the policy of hydroelectric development.

Granting the rapid growth in the number and capacity of generating stations, has it occurred to you that the remarkable increase in generating equipment, requiring an investment of over two and one-quarter billion dollars is not the result of the promoting capitalist, but rather of the concentrated efforts of the commercial engineer, the central station operator and the manufacturer all working along aggressive and consistent lines in the centers of population? That the steadily increasing demand for "juice" is the natural sequence of commercial effort resulting in the use of current for the illumination of the home and the shop, the operation of the factory, the propelling of train, car, and vehicle in city and hamlet. Additional business will be secured from present urban consumers, as public utilities appreciate the advantages of electric cooking and heating, and grant rates that are conducive to the use of such appliances, but will the central station selfishly confine its efforts to the city, where constant shifting of consumers require a maximum of educational expense, or will the management of public utilities awake to the wonderful opportunity for increased current sales in the agricultural and rural sections, bringing electric service within the reach of the farmer?

The applications of electricity to the farm are manifold. Larger revenue per dollar invested, covering a longer period of time per consumer, is possible from the agriculturalist than from any other source. To develop such a field of profit a quasi-public utility must bring its service within the reach of the rural user, and demonstrate how electricity may be used advantageously.

The general lack of appreciation of the value of agricultural business by the central station, the hesitancy with which it grants a line extension which in a short time yields immense profit, the unwillingness to spend a liberal amount of money, commensurate with its ultimate value in educational purposes, lead to a series of papers in which motor and current consuming devices for farm house and field purposes will be discussed in the hope that the apathy which characterizes many central stations may be cast aside and a liberal, aggressive policy pursued in the development of the great revenue producing field, that of agricultural current sales.

It is evident that to develop the sales of current for agricultural purposes a plan of campaign must be pursued that in some respects is identical with that used for the securing of city business, yet deviating in many ways from the system of urban solicitation as now practiced by the majority of up-to-date central stations.

Summarizing, it should be remembered that it is the duty of the utility to bring its service within reach of the farmer and, where necessary, show him how to use it advantageously, all of which involves large expenditures commensurate with the development of the latent possibilities in rural business. On the other hand, the agriculturalist, the representative of the real wealth of any nation, is often a man of education who applies scientific principles to farming and is willing to utilize every means of increasing the productiveness of his land.

Co-operation with the farmer is mutually advantageous, representing as it does readiness to be served on the side of the agriculturalist.

Including the present paper, there are to appear sixteen separate and distinct discussions along the line of agricultural sales. These articles will cover many phases of "Readiness to Serve Methods" applied to Western rural communities and in brief are as follows:

1. Introductory—Summary and Explanatory.
2. Organization—agricultural sales department.
3. Card systems for records.
4. Methods of approach to customers.
5. Modernizing the country home.
6. Modernizing the farm buildings.
7. Electricity on other parts of the farm.
8. Electricity and irrigation—old methods.
9. Electricity and irrigation—new methods of water storage.
10. Electricity and reclamation—construction of system.
11. Electricity and reclamation—operation of system.
12. Electric transportation possibilities.
13. Investigation Bureau.
14. Publicity.
15. Suggestion on agricultural rates.
16. Country life vs. city.

PANAMA CANAL TOLLS.

1. On merchant vessels carrying passengers or cargo, $1.20 per net vessel ton—each 100 cubic feet—of actual earning capacity.

2. On vessels in ballast without passengers or cargo, 40 per cent less than the rate of tolls for vessels with passengers or cargo.

3. Upon naval vessels, other than transports, colliers, hospital ships and supply ships, 50 cents per displacement ton.

4. Upon army and navy transports, colliers, hospital ships and supply ships, $1.20 per net ton, the vessels to be measured by the same rules as are employed in determining the net tonnage of merchant vessels.

ELECTRICAL PUMPING AND IRRIGATION

DESIGN OF CANAL CROSS SECTIONS.

BY B. A. ETCHEVERRY.

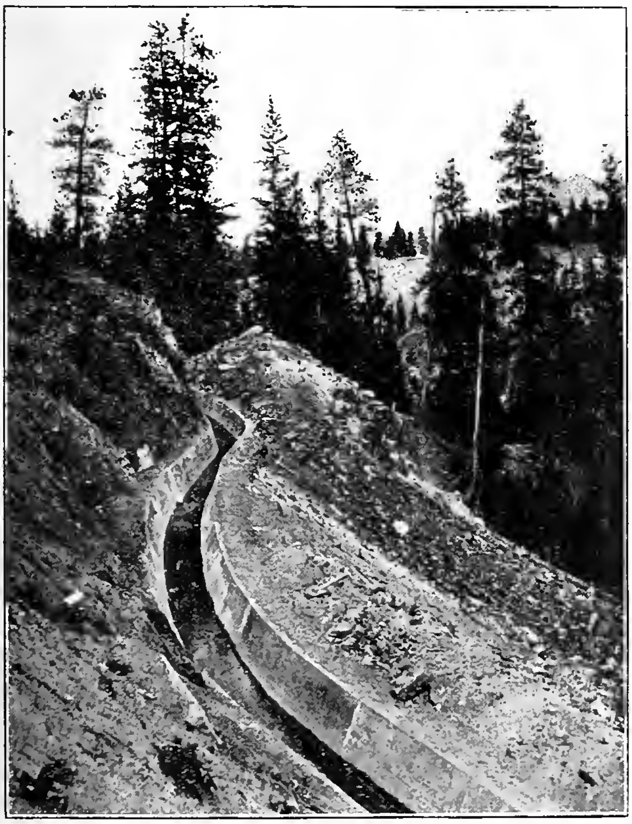
Considerations Entering Into the Design of the Form of Canal Sections.

The section with the best hydraulic elements is not in many cases the most feasible, for there are practical considerations which will often justify a shallower section of the same carrying capacity. The factors on which the design of cross sections for irrigation canals is based are:

1st. The cost of construction for lined and unlined canals.
2nd. Safety.
3rd. Absorption, percolation, evaporation.
4th. Purpose for which canal is to be used.
5th. Limitations because of grade and velocity.

1st. Cost of Construction.

The cost of excavation will depend not only on the volume, but also on the unit cost of construction which is affected by the depth of excavation, the side slopes, the material which may be encountered by increased depth, etc. When a canal is lined, the cost of lining, especially if concrete is used, will be the main item. To make it a minimum, it may be best to use the cross section having least wetted perimeter. The decreased cost of lining for such a section and the smaller volume of excavation, especially on hillsides, will often more than balance the unit cost of excavation.



Concrete Lined Canal, South Kelowna System, British Columbia.

2nd. Safety.

The safety against breaks is dependent on the depth of water in the canal and mainly on the proportion of this depth which is in fill. In a deep canal, the pressure, which depends on the depth of water, can exert a greater force on the banks or can produce a larger velocity through holes or breaks started by burrowing animals.

3rd. Absorption, percolation, evaporation.

The first two factors are intimately related and the relation depends on so many varying conditions that it cannot be stated numerically. The losses due to these two factors are commonly spoken of as seepage losses. By absorption loss is meant the loss due to the action of capillarity; and by percolation, the loss due to the action of gravity. If in a canal capillarity alone were acting, then the loss of water through the soil would follow the laws of capillarity. The water would pass from the wet surface to the dry soil surrounding it, moving horizontally as well as vertically, and would stop when it had reached the maximum limit of capillarity, which varies with the character of the soil. This capillary area surrounding the canal may, especially with canals in embankment, extend up to the surface and some of the water will be lost by evaporation. This action as well as evaporation caused by the air motion in the soil, will produce a continuous rate of absorption, which, however, is not of great magnitude. It is, however, modified by percolation. The water lost by percolation travels downward, because of the force of gravity, to the subsoil beyond the above limit of capillary action. This water is disseminated laterally by capillarity and in that way the capillary area is increased. The water loss by percolation will, if sufficient, ultimately reach the water table and pass as an underflow to a drainage channel. The percolation loss is, no doubt, of much greater importance than the absorption loss. The absorption loss will vary with the wetted perimeter, with the character of the soil, and with the position of the canal, whether in cut or fill. The percolation loss caused by the water passing from the canal into the subsoil through the small, crooked channels formed by the interstices between the soil particles must depend on

Heavy Rock Cut, Truckee Canal.

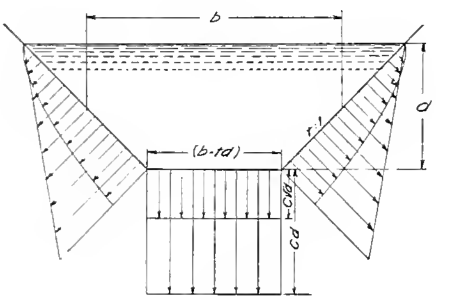
the depth of water in the canal. The most reliable formulae derived for the flow of water in capillary tubes or between soil particles show that the velocity increases with some power of the diameter of the particles, and with the first power of the slope or head. That it may vary with the square root of head instead of the first power is shown by the following experiment made by the Irrigation Investigations Office of the United States Department of Agriculture. Tanks were filled with three feet of soil, held by a mesh screen at the bottom; a constant depth of water was maintained on the surface of the soil, and the seepage water caught and weighed. With an ordinary clay loam the following results were obtained:

(1) Depth of water in inches.	(2) Square root of depth.	(3) Pounds of water lost per hour.	(4) Ratio of square root of depth to loss of water in pounds.
36	6.	4.51	1.33
30	5.47	4.06	1.34
24	4.90	3.48	1.40
18	4.24	3.11	1.36
12	3.46	2.68	1.30
6	2.45	2.38	1.03

These results should not be taken as conclusive.

Other factors affecting absorption and percolation are the height of the ground water level, the temperature and the velocity of flow in the canal.

An increase in temperature decreases the viscosity of water, which will increase the rate of percolation. In a shallow canal the temperature of the water is higher than in a deep canal.



Absorption and Percolation Diagram.

The velocity of water in the canal affects the seepage loss, because the water moving at right angles to the capillary and percolation flow interferes with it. Experiments made by the United States Department of Agriculture show that the seepage loss is greater with still water than with water in motion. A very small velocity does not seem to make a great difference, but a moderate bottom velocity, probably of 1.5 feet per second for shallow canals, and greater for deep canals, has a great effect. A velocity higher than this will further decrease the seepage, but the difference will not be so marked as the difference between 0 velocity and 1.5 feet per second (greater for deep canals). To summarize the above considerations, it is probably safe to state that seepage increases either with the first power of the depth or perhaps with the square root of the depth of water in the canal, with the temperature, and with the wetted perimeter, and it decreases with an increase in canal velocity.

The evaporation loss is usually very small, as compared with the seepage loss, and in most cases need not be taken into consideration in designing irrigation canals. On one of the largest systems in the San Joaquin Valley it has been estimated that for a total length of canals of 165 miles the evaporation loss was .9 per cent of the flow diverted; the total seepage loss was 28 per cent, or 30 times greater.

4th. Purpose for Which Canal Is to Be Used.

A canal may be intended for (a) a diversion line, (b) main laterals, (c) private ditches and farm ditches. For a diversion line, especially on a side hill, the deeper section has the advantage that it requires less excavation and has a smaller wetted perimeter. This will decrease the cost of excavation and also the cost of lining where the canal is to be lined. On the other hand, the safety is not so great. For main laterals, and especially farm laterals, it is important that the main body of the water be kept as high as practicable with respect to the ground surface.

5th. Limitations Because of Grade and Velocity.

When the grade available is large and to reduce the necessity for falls, it may be necessary to use a shallow section to obtain velocity which is not excessive. When the grade is small it may be desirable to use the section with greatest hydraulic radius to obtain the maximum velocity.

[To be continued.]

ELECTRIC RAILWAY AMENDMENTS TO SAN FRANCISCO CHARTER.

Bion J. Arnold's Preliminary Report No. 13 is devoted to a consideration of the unsatisfactoriness of the present franchise regulations, the inadequacy of the charter amendments originally proposed, and the necessity for the passage of Amendment No. 34 as submitted by Delos F. Wilcox, E. A. Walcott and Bion J. Arnold.

Under existing franchises no extensions of street railways, gas or water pipes or electric lines can be made. If the proposed amendment is defeated another opportunity to remedy these conditions will not offer itself for two years.

The other charter amendments create a Public Service Commission for the city and county, consisting of three members appointed by the Mayor.

Briefly expressed, the purposes of Amendment No. 34 are:

First—To provide in the charter a "blanket" enabling act, outlining the general terms under which detailed municipal ordinances may later be prepared by the Board of Supervisors, subject to the referendum vote.

Second—To establish the foundation for a comprehensive franchise or administrative code, defining in specific terms the conditions and limitations under which all new franchises may be granted by the city to private operators.

Third—To empower the Board of Supervisors to carry out a comprehensive resettlement or adjustment franchise policy by means of which existing grants to private operators may be merged into those of new or adjusted grants containing specific conditions calculated to remove the present obstacles to adequate service and continued expansion.

RATE FIXING AND APPRAISAL

Practical Illustration in the Determination of Gas Rates.

(Concluded.)

BY C. L. CORY.

In order to set forth some additional information in connection with such a gas manufacturing plant and distribution system, it may be assumed in the various analyses, and perhaps with good reason, that the intangible value or going value of the business has been exaggerated. In this particular instance, the going value has been assumed to be the equivalent of about 10 per cent of the total value, although in arriving at the going value, the actual cost of developing the business has been utilized and it is merely a coincidence that the going value in the aggregate is equivalent to about 10 per cent of the total value of the system.

Again, it is possible that the existing value, or the original cost less depreciation to date, to which is added a sum estimated to be equivalent to the value of the going concern, should be used instead of the value of the plant and system based upon the cost of reproduction new to which is added the going value of the company with its established business.

Tables VI to X inclusive give the figures based upon the existing value of the gas manufacturing plant and sytem, which tables should be compared with Tables I to V inclusive, which give the figures based upon the total value undepreciated.

Table VI gives the total existing value, or investment, as $290,000 which when compared with the former figure of $362,500 would indicate that the total depreciation to date is $72,500.

Table VI is similar to Table I and shows the depreciated investment per thousand cubic feet of gas installed capacity as $1.93, the investment per thousand

TABLE VI.

Existing value of gas manufacturing plant including holders, distribution system and services, meters, etc., per installed capacity—per 1000 cubic feet of gas manufactured and per 1000 cubic feet of gas sold.

Portion of System—	Investm't.	Investment per 1000 Cu. Ft. Installed Capacity	Gas M'f'd.	Gas Sold
Gas Manufacturing Plant	$156,000	$1.04	$2.20	$2.60
Distribution System	100,000	.66	1.41	1.67
Services, Meters, etc.	34,000	.23	.48	.57
Totals	$290,000	$1.93	$4.09	$4.84

cubic feet of gas manufactured, $4.09, and the investment per thousand cubic feet of gas sold $4.84.

Tables VII, VIII and IX show the items and the totals which enter into the generating, distribution and serving, metering, billing and collection costs, and Table IX gives the summary as well as the total annual revenue required to meet operating expenses and provide an adequate return upon the investment as well as the average rate per thousand cubic feet of gas sold.

TABLE VII.

Annual Generating Costs and Cost of Generation per 1000 Cubic Feet of Gas Sold.

Item—	Per Cent	Yearly Total	Per 1000 Cu. Ft.
Return on investment	8 per cent	$12,480	$0.208
Taxes	Based upon gross receipts	1,245	.021
Depreciation	Av. on depreciable portion—5 per ct.	5,350	.089
Oil		14,300	
Station wages, maintenance, operation and station supplies		10,150	.169
Total		$43,525	$0.726

TABLE VIII.

Annual distribution (not including services, meters, etc.), charges, and cost per 1000 feet of gas sold, and delivered to customers.

Item—	Per Cent	Yearly Total	Per 1000 Cu. Ft.
Return on investment	8 per cent	$ 8,000	$0.134
Taxes	Based upon gross receipts	800	.013
Depreciation	Av. on depreciable portion—3 per ct.	3,250	.054
Maintenance and operation		5,900	.098
Total		$17,950	$0.299

TABLE IX.

Annual services, metering, billing and collection charges and cost per 1000 cubic feet of gas sold and delivered to customers.

Item—	Per Cent	Yearly Total	Per 1000 Cu. Ft.
Return on investment	8 per cent	$ 2,720	$0.046
Taxes	Based upon gross receipts	400	.007
Depreciation	Av. on depreciable portion—4 per ct.	1,750	.029
Salaries, wages, office expense, etc.		12,000	.200
Total		$16,870	$0.282

If the value of the plant as depreciated to date, including the proper estimate of the additional value as a going concern, is $290,000, the total annual revenue necessary is $78,345. If no more than 60,000,000 cubic feet of gas per annum can be sold, the average return is practically $1.31 per thousand cubic feet. In other words, if the rate for gas service is based upon the value of the plant new, the selling price of gas would be $1.40 while on the other hand the rate would be $1.31 per thousand cubic feet if the rate for gas service were determined upon the existing or depreciated value of the entire plant.

At this time it may be well to state that when a public utility company charges off each year a bona fide sum to cover depreciation, then either one of two methods should be followed by such a corporation.

First:—That there be expended, not each year necessarily, but on the average throughout the life of the system, an amount equal to this depreciation fund in order that the plant and system may be maintained in its original or 100 per cent condition.

Second:—If this is not done by such a public utility company, then the rate of return should not be based upon the cost of reproduction new but in equity upon the existing value which may in general be determined by reducing the original value by the depreciation of the plant and system to date.

Referring to Tables V and X, there is an important fact to be noted.

It would seem that in certain portions of California, we are soon to be provided with natural gas. It may not be necessary to artificially manufacture gas as heretofore. I have heard it stated by many very well-meaning laymen that when this natural gas is available, it can be delivered to the customers of the present gas companies for a very small fraction of its present cost. Let us see what would be the result of delivering gas at no cost whatsoever to this small community of about 12,000 inhabitants, if this natural gas is distributed to customers throughout the present distribution systems.

As set forth in Table V, the total cost of distributing,

serving, metering, etc., per thousand cubic feet of gas sold is the sum of $.332 and $.293 or $.625.

In Table X, the corresponding cost of distributing, serving, metering, etc., is the sum of $.299 and $.282, or $.581. In other words, assuming that such local

TABLE X.
Total Cost of Gas Service per 1000 Cubic Feet of Gas Sold, and Delivered to Customers.

Item—	Yearly Total	Per 1000 Cu. Ft.
Generation	$43,525	$0.726
Distribution	17,950	.299
Service, metering, etc.	16,870	.282
Total	$78,345	$1.307

gas manufacturing and distributing companies were to receive the natural gas free of any cost whatsoever (which is manifestly absurd as a business proposition) and in addition were not allowed even interest and depreciation upon their present manufacturing plants, because they would probably be idle, the rate for gas service in this community would be about 60 cents per thousand.

Figure I shows graphically by curves some interesting facts relating to the plant which I have used for the purposes of illustration. From 1905 to 1912, records were available so that these curves could be compiled. The figure includes the following curves:

1. Gross earnings.
2. Quantity of gas sold annually.
3. Cu. ft. of gas sold per customer per month.
4. Number of customers.
5. Number of meters.
6. Number of services.
7. Gross return in dollars per thousand cu. ft. of gas sold.
8. Rate per thousand cu. ft. of gas delivered to customers.

These curves vividly illustrate some of the points to which reference has been made above.

Some of the risks involved in the gas industry in a small, isolated community were referred to. The effect of the financial panic in the latter part of 1907 and 1908 upon the business of this company is observable at a glance. The gross earnings from 1905 steadily increased until 1908 and there then resulted a general stagnation in the business which continued for more than two years. Quite independent of the rate per thousand cubic feet of gas sold the quantity delivered to customers suffered a decided reduction.

Curve 3 is of the most vital importance to those interested in the manufacture and sale of gas. Beginning with the latter part of 1906 the consumption of gas per customer began to increase from 1,900 cubic feet per month until three years later it was 2,700 cubic feet per month, or an increased consumption per month per customer of nearly 50 per cent. When the effect of the financial stringency began seriously to be felt, however, the consumption per customer again decreased so that even at the same rate or cost per thousand cubic feet of gas, the consumption per customer per month was on December 31, 1910, reduced to 2,300 cubic feet per month per customer. After this date the consumption per month per customer was still further reduced, due possibly to an increase in the rate or cost of gas per thousand cubic feet, to 2,000 cubic feet per customer per month on January 1, 1912, since which date there is some indication of improvement.

As repeatedly maintained, all efforts to increase the average consumption of gas per customer tends to decrease the price at which gas may be sold and, again, with good service, a decrease in the price at which gas may be sold acts as a stimulant to increase the sales not only in the gross but in the consumption per customer as well.

The development of industrial business or the consumption of gas in large quantities, if such is possible in the community, and the introduction of new and economical gas appliances for domestic purposes are both very effective in increasing the amount of gas used per service or per customer.

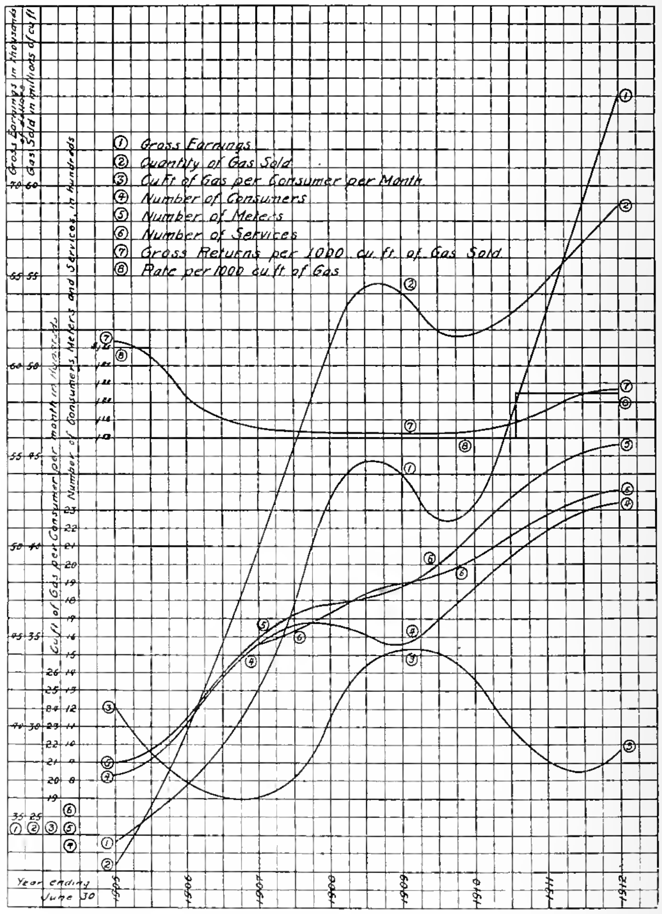


Fig. 1. Curve Showing Yearly Growth of Earnings and Relevant Data.

Curves 4, 5 and 6 show what happens during financial depressions, either local or general, in rendering many services and meters idle. On June 30, 1907, there was very little difference in the number of services, meters and consumers respectively, but two years later there were many idle services and meters which again is not a good business situation for the gas company.

Curves 7 and 8 indicate the average gross return per thousand cubic feet of gas sold and the rate in force at the particular time respectively.

A study of a small gas manufacturing and distributing plant such as the one under consideration indicates what is well-known and extensively practiced on the Pacific Coast, namely, the increased economy and better service resulting from a large gas generating plant

from which is distributed at high pressure the gas used in a number of small communities. The fixed charges in the manufacture of gas bears such an important relation to the total cost of manufacture that increasing the amount of gas made in a single plant very materially reduces the total cost of the gas delivered to the holder.

Finally it is evident that it may not be best for a small gas company in analyzing the situation, somewhat as above indicated, to conclude that it is desirable to attempt to maintain a rate for gas of $1.30 of $1.40 per thousand cubic feet of gas sold. Much better would it be to make every effort, which must include the best possible service, to increase the output of the plant and the resultant gas sales to the end that everybody would be benefited, the company as well as the people of the community. The proper development of a city and its environs will be the more fully realized if from a given gas manufacturing plant and system, 90,000,000 cubic feet of gas may be sold at an average rate of $1.00 per thousand instead of 60,000,000 cubic feet of gas being sold at a 50 per cent greater rate or $1.50 per thousand. The required increase in investment, even if such is necessary, will not be in proportion to the increased sales, and good service and cheaper gas, with the rapid advances being made in domestic gas appliances, can only result in a reasonably prosperous community, in a permanent increase, not only in the total gas sales, but also in the amount of gas delivered to each customer during any given period.

PROPOSED LAW FOR EXPERT WITNESSES.

An act to amend the Code of Civil Procedure of California by adding thereto a new section to be numbered and known as Section 1871, relating to expert witnesses, their appointment by the Court, or a judge thereof, and providing for their compensation and manner of examination.

The People of the State of California, represented in Senate and Assembly, do enact as follows:

Section 1: A new section is hereby added to the Code of Civil Procedure of California, to be numbered and known as Section 1871, and to read as follows.

1871: Whenever it shall be made to appear to any trial court, or judge thereof, either before or during the trial of any action or proceeding, civil or criminal, pending before such court, that expert evidence is, or will be, necessary or desired by the court or any party to such action or proceeding, such court or judge may, on motion of any party, or on motion of such court or judge, appoint one or more experts to investigate and testify at the trial of such action or proceeding relative to the matter or matters as to which such expert evidence is, or will be necessary or desired and such court or judge may fix the compensation of such expert or experts for such services in addition to his or their services as a witness or witnesses at such amount or amounts as to the court or judge may seem reasonable. In all criminal actions and proceedings such compensation so fixed shall be a charge against the county in which such action or proceeding is pending and shall be paid out of the treasury of such county on order of the court or judge. In all civil actions and proceedings such compensation shall, in the first instance, be apportioned and charged to the several parties in such proportion as the court or judge may determine and may thereafter be taxed and allowed in like manner as other costs. Nothing contained in this section shall be deemed or construed so as to prevent any party to any action or proceeding from producing other expert evidence as to such matter or matters; but where other expert witnesses are called by a party to an action or proceeding they shall be entitled to the ordinary witness fees only and such witness fees shall be taxed and allowed in like manner as other witness fees. Any expert so appointed by the court may be called and examined as a witness by any party to such action or proceeding or by the court itself and, when called and examined by the court, may be cross-examined by the several parties to the action or proceeding in such order as the court may direct. When such witness is called and examined by the court, the several parties shall have the same right to object to the questions asked and the evidence adduced as though such witness were called and examined by an adverse party.

This act has been submitted for the approval and suggestions from the California Sections of the several engineering and architectural societies, as well as the Bar Association and the medical societies. H. W. Crozier, chairman of the San Francisco Section of the American Institute of Electrical Engineers, has appointed a committee consisting of A. M. Hunt, F. G. Baum and A. H. Babcock to report at the meeting on November 29th.

In connection with this matter it is of interest to note the opinion of John M. Olin of Madison, Wis., who is handling the Tucson Rate Case, and to whom the matter had been previously submitted:

"It would seem to me a pretty grave question as to whether it is wise at this time to have any law passed that should provide for the appointment by the court of expert witnesses on engineering matters. I think that such a law as this in relation to proceedings in court in criminal cases would be a good thing.

"If such a law was passed, it should be so passed that before any person is appointed by the court as such expert, the parties interested should be notified and an opportunity given as to what person or persons should be appointed. In other words, the matter ought to be placed in very much the same situation as in the case of the appointment of arbitrators or the appointment of a commission to determine the value of property. If the law was framed so as to have thrown about it the proper safeguards, good might come of it.

"The law ought also to provide that nobody could be appointed who was in any way interested in the controversy."

ELECTRICITY PRODUCES FOURTH LETTUCE CROP.

According to the Post-Intelligencer of Seattle, by using electricity, the Walla Walla Hot House Vegetable Company has "slipped one over" on lettuce, and as a result four crops are now grown where only three were produced. The theory is that lettuce doesn't know when night comes and keeps on growing. Results are obtained by the use of eight 2000 candle power flaming arc lights as soon as the sun goes down.

TO DEMAGNETIZE A WATCH.

Suspend the watch by a strong cord; twist the cord so that when released the watch will spin for several seconds, release it, and while the watch is spinning slowly approach it with the positive pole of any strong magnet and then slowly withdraw the magnet. Do this a number of times and be sure that the magnet is not near the watch when it ceases to rotate or afterward.

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POWER AND GAS

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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CONTENTS

The Expert Witness and the Court

Too long have engineers suffered from partisan criticism in hotly contested legal controversies. The expert, paid and retained by a party to an issue, though acting to the best of his knowledge and belief, still invokes the undertalk of the opposite side when an opinion is given that materially affects the ultimate outcome of the suit. Of late years, the engineering profession has assumed an ethical standing in the professional world that places it in the foremost rank of honor and trust. Why, then, should our laws and court procedures be such that the expert be placed often in a compromising position? It is unjust to the high ideals entertained by the engineering fraternity at large.

The Pacific Association of Consulting Engineers, some months back, undertook a campaign to alter the court procedure in the retaining of expert witnesses. Not only have the engineers of the coast been considered regarding this effort, but also the medical and particularly the legal fraternity have been informed and asked to co-operate. Among the latter class of men a firm endorsement of the agitation is heard on all sides. As our legislators are largely drawn from the legal fraternity, this augurs well for possible fruitful results. Already a proposed amendment to the Code of Civil Procedure of California is going the rounds. A copy of this proposal may be found on another page of this issue. As the agitation in California is the first of its kind to materialize in the West, the other commonwealths of the West will watch the progress with much interest.

The duties of the consulting expert witness are truly of the most unbiased nature—the speaking of the truth brought to consciousness in the expert's mind after years of effective and thoughtful experience. No partisan leaning should ever be tolerated; nor will the engineer, faithful to the high ideals of his profession, allow his testimony to have the faintest touch of partisan coloring. The present practice of the courts, nevertheless, puts the engineer in the embarrassing position of being called upon to speak the dictates of unprejudiced judgment and yet having to bear the sting of bitter insinuations should that decision lean toward his client.

Any enactment empowering the retaining of engineers by the court to appear as witnesses must, however, be considered with the most thoughtful reflection. Undoubtedly in criminal cases such procedure, under the proper safeguards, may prove beneficial. On the other hand, the ends of justice in suits involving damage claims and other forms of civil procedure may often go far astray under the combination of a dishonest judge and an unscrupulous self-heralded expert.

It would seem that a proper solution of the difficulty would be for an enactment empowering the court to appoint an expert, when needed, similar to the method usually in force in the appointment of arbitrators or commissions in the fixing of property valuation.

This would give all parties interested in the controversy due notice of the appointment of such experts and likewise there should be given a full opportunity to investigate the fitness of such appointees and an opportunity to file objections thereto. Add to this the stipulation that no one in any manner interested shall serve on such commission and also include a clear and concise definition of what constitutes the expert and such an enactment may be made to materially serve the ends of justice.

Electric Smelting of Iron

The readers of this journal have followed with interest week by week, the unfolding of new applications of electrical energy on the farm. It is interesting to note that industrial applications, too, are not lacking. Perhaps no more potent industrial application for development of Western manufacturing is possible than that of the opening up of the great bodies of iron ore found throughout that district lying west of the Rocky mountains.

While iron deposits have been found in quantities in many sections of the West, nature has distributed these blessings with lavish hand throughout the great state of California. On the Pitt River and the McCloud River, for instance, the contact between the diabase and the carboniferous limestone seems to be especially rich in magnetite. In reports of the U. S. Geological Survey it is stated that these ore bodies have been opened to a width of 40 ft. without exposing their limits and the occurrence of a vertical dip situated on the north slope would seem to indicate depth. The ore analysis runs 70 per cent iron, 1 or 2 per cent insoluble material, and only a trace of sulphur.

The problem of electrically smelting iron is not new. As early as 1880, Sir Wm. Siemens experimented upon these processes and his four conclusions are well borne out today, namely, that the electric smelters furnish a degree of temperature attainable theoretically unlimited. In the second place fusion may be effected in a perfectly neutral atmosphere. Again fusion can be carried on in a laboratory. And, finally, the limit of heat practically obtainable with the use of ordinary refractory materials is very high because in the electric furnace the fusing material is at a higher temperature than the crucible. On the other hand in the ordinary fusion, the temperature of the crucible exceeds that of the material fused within it.

After a number of years of careful investigation, the iron smelter at Heroult, in northern California, is now producing daily eighteen to twenty-one tons of high grade pig iron. The estimated cost of operating this plant on a commercial scale averages around $14 per ton. The successful consummation of this series of experiments means untold promise to our commercial West. Not only does it mean an unsurpassed market for enormous electrical powers, nor does it only mean the production of millions of dollars in natural wealth from the great undeveloped resources of the commonwealth of California, but even more, for it is difficult to foretell the hundreds of avenues of industries into which these dollars set moving will ultimately wend their way. The advent of oil has meant an untold blessing to the encouragement of manufacturing but now, with the promise of an iron output at rates comparable to Eastern conditions, the future of Western industries is indeed most bright.

Readiness to Serve Methods

"Back to the farm" has of late been so thoroughly discussed in the magazines of the country that some are prone to say the expression is hackneyed. The fact remains, nevertheless, that so emphatic has grown this movement, the power companies now find it to their interests to join in the stampede. Such an unprecedented awakening on the part of the central station calls into life new effort, new modes of procedure and, withal, an evolution in "Readiness to Serve Methods," as different from the city practice as is the rural life of the farmer from that of his well-groomed brother in the densely populated centers.

In the rural communities the organization of the sales force and the method of tabulating data must of necessity be different from the urban practice. Since the farmer leads an entirely different life in entirely different surroundings, the methods of approach on the part of the salesman must be in tune with these new surroundings. Modernizing the farm house, the barn, the bunkhouse and the dairy present new problems and especially so as cost data is meagre upon these subjects. Irrigation costs when storage reservoirs are not used, or when operated with such an elastic supply of water, add their quota of complications. Then, again, reclamation, drainage and pumping upon the low lands of the great valleys of the Sacramento and San Joaquin present new and promising fields of endeavor. Such cost data as does exist have never been published in detail. As to how a trouble or investigating department should be maintained and operated in a rural community likewise presents interesting features wholly different from similar organizations in the concentrated urban distribution centers. Finally, a discussion of rates to be charged in various classes of rural electrical application is of timely interest.

Ross B. Mateer contributes in this issue, the first of a series of sixteen articles which he is preparing on "Readiness to Serve Methods," with especial emphasis for the agricultural community. Mr. Mateer, as manager in charge of agricultural sales for the Great Western Power Company, has ample opportunity to observe and collect the best and most reliable data available. With a college engineering degree in 1899 and a three years' apprenticeship course following at the Westinghouse Electric & Manufacturing Company's Works, his scholastic training is of the best. Next followed years of professional service in Denver and New York, especially devoted to introduction of electric appliances and new power applications, under the various Doherty interests. At the former city he was connected with the Denver Gas & Electric Company and in the latter with the Combustion Utilities Company.

With such splendid experience in former years, and with an active life now busily engaged in the thick of an agricultural sales campaign in the Sacramento valley, our readers have in store in the contributions of Mr. Mateer, a rare treat.

PERSONALS.

G. I. Kinney, Pacific Coast manager of the Fort Wayne Electric Works, is at Seattle.

F. G. Leggett, Pacific Coast manager of Western Electric houses, is making a two weeks' business trip to Seattle.

H. A. Lauritzen, Pacific Coast manager for the Holophane Works of the General Electric Company is at Los Angeles.

Jos. Endert, manager and proprietor of the Valley Electric Supply Company at Bakersfield, Cal., was at San Francisco this week.

E. B. Bumsted, vice-president of the Oro Electric Corporation with headquarters at San Francisco, left for a two weeks' Eastern trip early this week.

E. P. Warner, formerly manager of the Western Electric Company's arc lamp department, has returned to Chicago, after a month's stay in San Francisco.

J. E. Watkins has returned to Vancouver, B. C., after inspecting the construction of the B. C. Electric Railway Company's new turbines at San Francisco.

C. H. Morse, Sr., president of Fairbanks, Morse & Company, and **W. E. Miller**, vice-president, are making a tour of inspection of the company's Pacific Coast offices.

Chas. W. Kendall has joined the sales department of the Utah Power Company at Ogden, Utah, having resigned from a similar position with the Des Moines Electric Company.

G. M. Simonson, formerly with the State Department of Engineering, at Sacramento, is now in the drafting department of the United Comstock Pumping Association at Virginia City, Nevada.

G. R. Cardinal has just joined the sale force of the Pacific States Electric Company as specialist on heating devices and fan motors, arriving at San Francisco this week from Schenectady.

L. H. Newbert, manager of the appliance department of the Pacific Gas & Electric Company, will attend the convention of the National Commercial Gas Association, at Atlanta, Ga., on December 26, 1912.

E. F. Sise, managing director of one of the Western Electric allied houses at Montreal, recently spent a few days in San Francisco, on his way home from an extended trip throughout Western Canada.

R. F. Oakes, general manager of the American Ever Ready Company, has returned to San Francisco from a month's trip through the East. Early in December he plans to leave on a five months' trip through the Orient.

Wm. T. Maddix, formerly superintendent of the southern division of the Pacific Electric Railway Company at Los Angeles, has been appointed assistant general manager of the Utah Light & Railway Company at Salt Lake City.

John Coffee Hayes, president of the Mt. Whitney Power & Electric Light Company of Visalia, Cal., was at San Francisco this week with regard to the California Railroad Commission hearing authorizing his company to issue $250,000 in bonds for new construction.

R. H. Beamer of Woodland, Cal., has been appointed general manager of the Yolo County Consolidated Water & Power Company, which plans to utilize the water from Clear Lake, Cal., for an irrigation and power development. **Roy M. Pike** is president of the company.

D. E. Widdersheim, formerly superintendent of the gas and water departments of the Oregon Power Company, Eugene, Oregon, has been transferred to the new business department of the Western States Gas & Electric Company, Stockton, Cal. **A. P. Tillis** has succeeded Mr. Widdersheim at Eugene.

A. R. Rice, inspector of wireless telegraphy, appointed under the new act of congress for the district embracing Washington and Alaska, arrived in Seattle recently. The act which goes into effect December 13, requires that examinations be taken by operators, and compels amateurs to hold their wave lengths under 200 meters.

F. W. Hild, general manager of the Portland Railway, Light & Power Company, has been elected president of the company's Electric Club; the other officers being **A. C. McMicken**, vice-president, and **M. B. Grenfell**, secretary. Arrangements have been made for many of the club members to take up university extension work under the auspices of professors from the University of Oregon.

M. T. Crawford, superintendent of transmission Puget Sound Traction, Light & Power Company, Seattle, Wash.; **H. W. Crozier**, electrical engineer with Sanderson & Porter, San Francisco; **Barry Dibble**, electrical engineer, with the U. S. Reclamation Service, at Minidoka, Idaho, and **R. W. Lowman**, consulting engineer at Los Altos, Cal., have been transferred to the grade of member of the American Institute of Electrical Engineers.

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, and member of the executive committee of the National Electric Light Association, delivered an illustrated lecture on the system and service of the company and on the remarkable developments in electrical power transmission on the Pacific Coast in the main auditorium of the Engineering Societies Building, New York City, on November 14, 1912. This address was given on the invitation of members of the national and local electrical engineering societies.

Gordon Kribs, who has been assistant to the chief engineer of the Pacific Power & Light Company of Portland, Oregon, for the past two years, has been transferred in the same capacity to the Texas Power & Light Company, Dallas, Texas. Formerly Mr. Kribs was electrical engineer for Smith, Kerry & Chase and had charge of all electrical engineering work in connection with the Mt. Hood Railway & Power Company, which was absorbed by the Portland Railway Light & Power Company. A luncheon at the Portland Hotel, Thursday noon —the 14th—was given Mr. Kribs by the engineers of the Pacific Power & Light Company which was attended by 51 members of the organization. At this luncheon he was presented with a leather bag as a token of the high esteem in which he was held by his associates. Mr. Kribs left for his new position Friday evening, the 15th.

MEETING NOTICES.

Pacific Coast Electrical Supply Jobbers' Association.

The electrical jobbers will meet at Catalina Island, Cal., December 5, 6 and 7 to enjoy the usual golf and other sports here afforded. There will also probably be an open joint meeting between jobbers and manufacturers.

Utah Electrical Club.

At a meeting held at the Salt Lake City Commercial Club, Thursday, November 14, 1912, plans were formed to launch an Electrical Club, to be known as the Utah Electrical Club. Another meeting will be held at the Commercial Club, Thursday, November 21, 1912. D. J. Dinwoodey is temporary chairman.

Jovian Club of San Francisco.

A well attended meeting was held at Tait's Tuesday, November 19th, 1912, at 12:15. N. W. Reed presented a paper entitled "The Relation of the Board of Fire Underwriters to Contractors, Jobbers and Manufacturers." This was followed by an enthusiastic discussion.

Engineering and Architectural Association of Portland.

G. E. H. Bond, manager of the Northwestern Land Products Show, was the speaker at the Engineers' Luncheon on Tuesday, the 12th. He dwelt upon the very pertinent subject of the farmers of Oregon adapting themselves to the country and taking up diversified farming to a greater extent.

San Francisco Section, A. I. E. E.

The regular monthly meeting of the San Francisco Section of the American Institute of Electrical Engineers will be held in the New Montgomery street building of the Pacific Telephone and Telegraph Company at 8 o'clock P. M., November 29. Professor H. F. Fisher will present a paper on "Artificial Transmission Lines." An informal dinner will be held at Jule's Cafe at 6:15, to which all are invited to attend.

Seattle Section A. I. E. E.

The November meting of the Seattle Section, was held November 16th, in the assembly room, eighth floor of the Central Building, under the auspices of the Electric Lighting Group. Howard Joslyn, city electrician, presented a prepared discussion of the inside and outside wiring ordinances of the City of Seattle, several others also presenting prepared discussions. Many of the Electrical Contractors' Association attended and took part in this meeting. The discussions and proceedings were reported by a stenographer and will be published in the Journal of Electricity, Power & Gas later.

A. I. E. E. DIRECTORS' MEETING.

The regular meeting of the Board of Directors of the American Institute of Electrical Engineers was held in New York on Friday, November 8, 1912. Among the matters transacted the president was authorized to appoint a committee on the use of electricity in mines, similar in scope to the other technical committees of the Institute.

The Public Policy Committee reported upon the matters submitted to it at the last meeting of the Board in regard to the patent situation. The committee submitted for passage by the Board certain resolutions addressed to Congress, relating to the American patent situation. These resolutions, which were adopted by the Board subject to the approval of a majority of both the Public Policy and the Patent Committees, urge suspension of action on all patent bills now pending, and the appointment of a commission made up of unbiased, independent, non-partisan men of national standing, to investigate the American patent situation and to recommend to congress such action as may appear expedient.

The Public Policy Committee also reported upon certain communications and senate bills relating to the regulation of water powers, transmitted to the committee by President Mershon for suggestions as to the attitude of the Institute towards the proposed legislation and the advisability of the Institute's participation in hearings on bills of this nature. The following resolution was adopted by the Board, based upon the recommendations made by the committee:

Resolved, When it appears to the president and a majority of the members of the Public Policy Committee, that the question at issue in connection with a bill before congress is one purely of engineering, the board of directors would approve his appointing a committee or delegation to confer with the committee of congress before which the bill is pending, with reference to the engineering questions involved.

The International Electro-technical Commission, through the United States National Committee, acknowledged the receipt of an official invitation from the president and board of directors of the Panama-Pacific Universal Exposition to hold the 1915 meeting of the commission in San Francisco, and requested the U. S. Committee, through the board of directors of the A. I. E. E. kindly to express to the exposition authorities its sincere thanks and appreciation of the honor of being invited to participate in the celebrating of the completion of the wonderful work at Panama, the achievement of which is calling forth the admiration of the civilized world. The board authorized the president and secretary to communicate with the exposition authorities accordingly.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

November 9.

The Railroad Commission effected a reduction from 30 cents to 25 cents in the telephone rates between San Francisco and Hayward, and Oakland and the towns of Mill Valley, Palo Alto, Redwood City, San Mateo and San Rafael. The commission also reached an adjustment with the Western Union Telegraph Company, canceling the extra service charge of 25 cents for delivering telegrams to Stanford University.

The Market Street Railway Company of San Francisco, applied for authority to issue $2,150,000 of gold bonds to be used as collateral security for an issue of $2,350,000 of gold notes of the United Railroads. The United Railroads applied for permission to issue $2,350,000 of notes, the proceeds to be applied toward the payment and discharge of $3,000,000 of bonds of the Market Street Cable Railway and $350,000 of bonds of the Park & Cliff House Railway.

The Southwestern Home Telephone Company of Winchester, Riverside county, applied for authority to raise its rates from 90 cents to $1.50 per month.

November 11.

The Pacific Light & Power Corporation applied for authority to purchase the electric distributing system of the Eagle Rock Water Company, of Los Angeles county, for $22,500, and asked for permission to extend its electrical system in the city of Eagle Rock.

November 12.

The Mt. Whitney Power & Electric Company applied for permission to issue $250,000 of bonds, the proceeds to be used in constructing generating plants and a reservoir on the Kaweah River.

The Little Rock Power & Water Company, of Los Angeles county, applied for permission to issue 3000 shares of stock and $5,000,000 of bonds. The greater part of the stock is desired for use in the purchase of all rights and interests to water and water rights in Little Rock Creek, Los Angeles county. The company proposes to use the proceeds from the $5,000,000 of bonds to construct a power plant and distributing system.

The City of Alhambra intervened in the case in which the Pacific Telephone & Telegraph Company applied for permission to purchase the San Gabriel Valley Home Telephone Company.

Authority was granted to the San Jose Terminal Railway Company to issue $200,000 of bonds for the construction of an electric line of railway from San Jose to Alviso, at tidewater. Arrangements have been made with an existing boat line to handle traffic between Alviso and San Francisco.

November 13.

The Imperial Gas Company, operating in Imperial Valley, filed a supplemental application, asking for authority to issue $200,000 in bonds for the purpose of discharging outstanding obligations and for constructing new gas mains and distributing systems in the cities of the Imperial Valley.

November 14.

The Commission rendered a decision granting permission to the Southern California Utilities Company to issue $10,000,000 of bonds. The proceeds of these bonds will be used for the development of an extensive land and irrigation system embracing 30,000 acres in Riverside county.

A decision was rendered granting permission to the San Diego, Riverside & Los Angeles Railway Company to issue $2,500,000 of bonds. The Commission criticised several transactions of the corporation, calling special attention to the issuance of its entire stock of $8,000,000 between March 12 and March 23, the effective date of the Public Utilities Act.

Permission was granted to the San Diego Consolidated Gas & Electric Company to modify its trust deed to include additional property recently acquired by the corporation.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

ADDENDA TO 1911 NATIONAL ELECTRIC CODE RULES.

Underwriters' Equitable Rating Bureau, Portland, Oregon, November 1, 1912.

Rule 17. **Underground Conductors.**—(Underground services only for D. C.)—

1. When the underground system is extended on the front of buildings and the service is brought through a 2-pole fuse block in the junction box, then when a new service is added for a sign, a motor, or a new lighting service, etc., we require a switch which will disconnect all the wires; i. e., 2-wire service, a 2-pole switch; 3-wire service, a 3-pole switch; and in every case a 2-pole cutout. The neutral for a 3-wire service may be coppered, but the switch on a 3-wire service must disconnect the neutral wire.

2. When the underground service enters a building and passes through a main line switch for this building, then it is optional whether or not an additional switch is furnished.

Underground Services. In all cases except as stated above, underground services should be taken up individually with the Inspection Department.

Rule 19b. **Switches, Cutouts, etc.**—All switches and fuses in basements must be placed in approved cabinets, as they are generally exposed to mechanical injury, piling of stock, etc.

Rule 23d. **Low Voltage Apparatus.**—When an approved transforming device is connected to a primary source of energy, such as a lighting or power circuit, and a secondary volage is obtained, the installation should be classified in the following manner:

(1) When the secondary voltage is 10 volts, more or less, the current being any value, and when the apparatus is used for light, heat or power purposes, both primary and secondary must be installed according to Class C of the National Electrical Code.

(2) When the secondary voltage does not exceed 24 volts, and the current carrying part of the apparatus is not capable of carrying 10 amperes, the system being used for bell-ringing and for similar signaling work, it will be necessary to install the primary wiring only in accordance with Class C, and the secondary according to Class E, of the National Electrical Code.

(3) When the secondary voltage is greater than 24 volts, the current being any value, and the apparatus installed being used for any purpose whatsoever, both primary and secondary must be installed, according to Class C of the National Electrical Code.

(4) When the secondary voltage is less than 10 volts and the current carrying parts of the apparatus are capable of carrying more than 10 amperes, the system being used for any purpose whatsoever, the primary wiring must be installed according to Class C, and the secondary wiring according to Class E, of the National Electrical Code.

Rule 26f. **Wires.**—All attics must be bored and bushed. Knobbing under roof joist and over floor joist will not be approved.

Rule 26k. **Wood Moulding.**—This department will not pass soft woods, such as cedar, redwood, white pine, Douglas fir, etc., for use as wooden moulding. All moulding must be made of hardwood, and have both outside and inside thoroughly painted with at least two coats of waterproof material or be impregnated with a moisture repellant.

Rule 26l. **Wire.**—This rule prohibits the use of moulding in damp places. Moulding, metal or wooden, must not be used on the outside of buildings or in the archway of doors or entrances that open directly on the street.

Rule 26r. **Wires.**—Second paragraph: Porcelain tubes must be used through timbers, walls and partitions. Flexible tubing will not be approved for this purpose. Also the crossing of pipes must be made with porcelain. The porcelain must be in a continuous piece at the point of crossing.

Rule 26r. **Wires.**—Last paragraph: "At distribution centers outlets or switches where space is limited, and the five-inch separation cannot be maintained, each wire must be separately encased in a continuous length of approved flexible tubing."

Four wires may be brought down between 2x4-inch studdings that are 14 inches apart. Six wires may be brought down between 2x6-inch studdings that are 14 inches apart, providing the wires are properly staggered. Headers must be placed as often as 18 inches apart.

Rule 26s. **Wires.**—Flexible tubing must not be used where it is exposed to moisture. Loom must not be used across water or steam pipes or down brick walls. Unless an air space of at least 4 inches between the laths and plaster and brick walls can be maintained, the wires must be run in approved conduit, installed according to Rules 27 and 28. Outlet boxes must not be concealed in ceiling, but conduit must extend to ceiling outlet.

Rule 26u. **Straight Electric Outlets.**—Circular loom must extend at least one inch beyond finished surface instead of one inch beyond backing. This applies to grounded surfaces, such as metal lath, metal ceiling, etc.

Rule 28f. **Interior Conduits.**—All conduit of a greater length than 15 feet and any run of conduit which carries more than 661 watts must be thoroughly grounded. This has special reference to the consumer's connection to the underground system.

Rule 30. **Fixtures.**—To secure safer methods in the installation of outside lights, we will require the following:

The arm of the fixture must be of approved conduit and on the outer end must be equipped with an approved condulet (Type A, B or E, two or three wires) or an approved weatherproof socket securely screwed to the end of the conduit, both to be turned downward. On the end attached to the building, if a crow's-foot is used, an approved condulet will also be required (Type D, two or three wires), but if the conduit extends through the wall it must terminate in an approved outlet box and have the wires separately encased in a piece of continuous flexible tubing from the last porcelain support to the Federal bushing in the box.

The above fixture may be decorated with ornamental iron work in any way desired, but must embody the above requirements.

Rule 30. **Fixtures.**—White or red lead must not be used when insulating joints. Some insulating compound, such as asphaltum, is preferable.

Rule 30a. **Fixtures.**—This department will not approve the following pieces of apparatus for canopy insulators: "Hard rubber or fiber clips for clamping over the edge of the canopies to hold fixtures away from ceilings"; also "Bushings made to insert between the lower edge of canopies and fixture stems."

When the fixtures are "Straight Electric," the fixtures must be supported by an approved insulating crow's-foot and the canopy insulated by an approved canopy insulator.

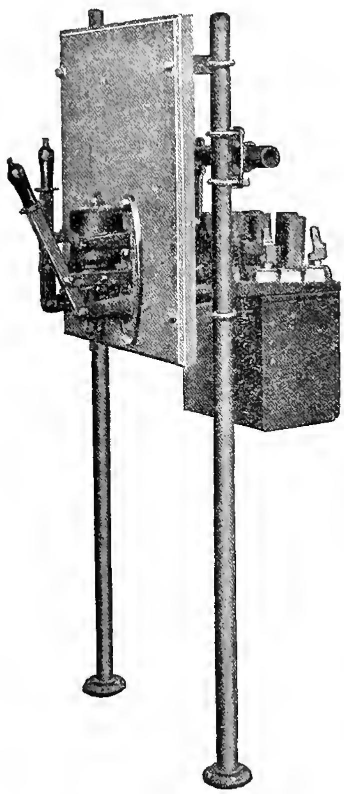
The October, 1911, List of Electrical Fittings gives a list of approved canopy insulators and insulating crow's-feet. Also a contractor may make approved canopy insulators with a strip of fiber at least one-sixteenth inch thick, separating all of the canopy at least three-sixteenths inch from the ceiling. These fiber strips to be securely fastened to the canopy by rivets.

[To be continued.]

INDUSTRIAL

NEW OIL SWITCH.

The smallest oil switch manufactured by the General Electric Company for switchboard mounting is known as the type F, form k-13. It was developed particularly for use in isolated and small plants and will provide adequate protection on a.c. circuits up to 200 amperes and 3300 volts. The general characteristics of this switch are similar to the larger and more expensive switches for switchboard mounting made by this company.



Automatic Triple-Pole, Double-Throw Switch on Panel Supports.

The entire mechanism and oil tank, except operating handle on front of board, are suspended from a single frame. The oil vessel is of heavy sheet metal lined with an insulating material and provided with barriers between poles. The contacts provide two breaks in each phase and open by gravity. They are of the well-known sliding wedge construction which not only gives a wiping motion to the contacts on opening and closing, thus keeping them clean, but also protects the actual current carrying surfaces from damage in breaking the arc.

This switch is made of double, triple and four-pole, nonautomatic and automatic for hand operation. It is fully described in the General Electric Company's Bulletin A-4001.

DISPLAY LIGHTING IN A BIG DEPARTMENT STORE.

When the new Bamberger store, in Newark, N. J., was planned, first consideration was given to secure an interior fitted only with equipment which would prove in every way adequate to the demands of a truly modern shop. Foremost amongst other essentials was the consideration of most effectively illuminating the goods displayed.

The interior show cases, aggregate a total of 3865 feet, or over three-quarters of a mile were they placed end to end. In the upper front corner of these cases were fixed Frink standard type of case reflectors with silver ripple reflecting glass to assure practically perfect distribution of light upon the goods within the case. The illuminating effects secured were without glare or shadow and highly gratifying to both customers and sales force.

About 250 feet of Frink window reflectors are used in the street display windows. There were set in a recess formed in the false ceilings about 8 in. from the plate glass front. The rear side of this recess was projected down below the ceiling line in the form of a molding and arranged and worked in as a part of the panelling effect of the ceiling. This projection, while not interfering in any way with the ornamental effect of the window ceiling, eliminates the possibility of "back reflection" which would be liable to occur were the light allowed to reflect directly upon the rear wall of windows.

The illumination of the rug display racks will be rather unique and very effective inasmuch as the arrangement provides for two intensities of light to secure approximately correct lighting effect for each article displayed. This rack consists of a number of inverted right angle triangular frames, pivoted on the vertical side between two horizontal bars so as to swing to and fro like a door or gate.

Arranged in semi-circular form directly outside of the limits of the arc described by the swinging members of this rug rack, and attached to the ceiling by means of permanent fixture blocks, are the Frink reflectors. They are so designed, with regard to diffusion of light by means of the arrangement of the silver ripple glass reflectors, as to uniformly illuminate the whole surface of the rugs under inspection.

A special shield arranged directly below the reflector serves to prevent the light from interfering with the customers vision of the rugs on display.

In the art gallery, which is arranged in the form of bays independent of the walls of the building, the Frink reflectors are supported on arms extending out from the top molding above the pictures. These reflectors are also so arranged as to evenly diffuse the light upon the goods without any reflection into customers' or salesman's eyes. From 15 to 60 watt tungsten bulbs will be used throughout depending upon the strength of illumination desired. This entire installation was handled and installed under the supervision of the H. W. Johns-Manville Company, New York, who are the sole selling agents for the entire line of Frink products.

NEW CATALOGUES.

Catalogue No. 12-A from The Hinman Hydraulic Manufacturing Company of Denver, Colorado, illustrates and describes various Canal and Reservoir Appliances, including head gates, gate lifts and pipe.

The General Electric Company has recently issued several new bulletins. No. A4004, describes the G-E Steam Flow Meter, and supersedes the company's previous bulletin on this subject. No. A4034 is devoted to Long Life Flame Arc Lamp, known as Type "W." This lamp is for street illumination, and is designed to operate on alternating current series circuits. No. A4036 describes Direct Current Exciter Panels for use in connection with alternating current generator panels when, for any reason, speed control of exciters is desired. This bulletin supersedes No. 4917. Isolated and Small Plant Switchboards for use with Gasolene-Electric Sets, and for Alternating and Direct Current, are described in Bulletin No. A4037. While designed primarily for use with the company's Gas-Electric Generating Sets, they are suitable for use in any generating units of the same rating, and are intended for small lighting plants.

NEWS NOTES

INCORPORATIONS.

SEATTLE, WASH.—Pacific Coast Light, Power & Railway Company, of Seattle, $50,000, by Albert H. Robinson, I. N. Robinson, K. C. Robinson.

SANTA MONICA, CAL.—Articles of incorporation have been filed for the Electric Products Corporation, with capital stock of $20,000. The directors are C. I. Hewshem, Frank E. Sweeney and Paul D. Lowse.

ILLUMINATION.

LOS ANGELES, CAL.—The Southern California Gas Company is making preparation to deliver natural gas to Torrance and other outlying districts of Southern California.

GLENDALE, CAL.—Erection of ornamental light standards in the residential section west of Glendale avenue, north of Riverside Drive to the city limits, has been completed and it is expected that lights will be in operation by December 1.

FULLERTON, CAL.—The Southern Counties Gas Company in addition to other improvements in its system in Orange county, will according to President R. Bain of Fullerton, shortly begin the laying of a 4-inch high pressure line to Fullerton.

REDONDO BEACH, CAL.—A petition is being circulated among business men and property owners to have ornamental lights in groups of five installed in the main thoroughfare from Diamond street to Marguerite avenue. It is planned to continue lights from Camino Real up Diamond street later.

LOS ANGELES, CAL.—John D. Reaves president of the San Gabriel Inter-City Commission, presented the proposition that a lighted-way from San Diego to San Francisco along the route taken by the State road, be constructed, composed of concrete lamp posts surmounted by 3 lights every 200 feet on alternate sides of the road.

SILVERTON, ORE.—A twenty-five year franchise has been granted to the Portland Railway, Light & Power Company for the free use of the city streets for carrying on an electric light business here in lieu of the privilege extended to the city in crossing the light company's land with the city water mains from the intake above the city.

MARYSVILLE, CAL.—In an endeavor to enter this county with a light and power plant, General Manager Van Der Nailen of the Oro Light & Power Company, appeared before the Yuba County Supervisors and asked that permission to bid on a franchise to erect poles and carry out the other necessary construction along the county highways outside the limits of incorporated towns be granted his company. Permission from the Railroad Commission has been granted the Oro Light & Power Company to obtain franchises throughout the county except in incorporated towns. The supervisors have taken the matter under advisement.

STOCKTON, CAL.—Three applications for franchises to supply electric power and light in Stockton have been filed. One applicant is the Oro Electric Company, another is John Raggio and the third is J. W. Goodwin, president of the Oro Electric Company. All three applicants are represented by Attorney C. L. Neumiller. Bids for the three franchises will be received December 17. J. W. Goodwin, president; R. L. Vander Nailen and E. B. Bumsted, vice-presidents; and F. H. Garbee, W. H. Orrich and Henry E. Adams were present to represent the interests of the company. They state that their company is prepared to enter the city almost at once and will make a bid for their franchise that will make competition almost useless. The Oro Company is already supplying power and lights for many of the farmers throughout the county in the north and east and its representatives say that the problem of entering Stockton is a small one.

WATERWORKS.

STOCKTON, CAL.—The Pacific Gas & Electric Company has been granted a franchise to lay and maintain water pipes, mains and conduits for the purpose of supplying water to the county of San Joaquin.

EUREKA, CAL.—Frank Langford, who is developing water power at the Ishi Pishi Falls on the Klamath River, to furnish electric power for an ore-reduction plant at Trinidad, has filed on 100 inches of water in Luffenholtz Creek for irrigation, domestic and manufacturing purposes.

SALEM, ORE.—On the site of the Willamette Power Company on the Santiam, in the Breitenbush region, which was recently contested by that company and the Hammond Lumber Company, William Hobson has filed a right in the office of the state water board of control, for 1000 second feet, generating a horsepower of 10,000. A general commercial use will be made of the water.

LOS ANGELES, CAL.—The Public Service Commission will begin plans at once for the distribution of aqueduct waters, as approved at the general election. William Mulholland, chief engineer, is at work on a plan to save approximately $50,000 in the first cutlay in bringing into the the city 2000 inches of water through Franklin Canyon line. Work has already begun on a 4000 foot tunnel through the Santa Monica mountains into Franklin canyon, also excavation for the dam for the lower reservoir.

TRANSMISSION.

KELSO, WASH.—The Oregon-Washington Corporation will construct a power line from here to Ostrander.

GLACIER, WASH.—The Washington Anthracite Power Company will build a power plant on Glacier Creek, three and one-half miles from here.

NANAIMO, B. C.—Taylor & Young, engineers, Metropolitan building, Vancouver, B. C., have been awarded the contract for installing a 450 h.p. Howden engine in the plant of Nanaimo Light Company.

MONTESANO, WASH.—The Elma Light & Power Company has filed a petition for a franchise for a term of 50 years to erect and maintain a line of poles and wires along county road between Elma and Satsop. A hearing has been set for December 2d.

LOS ANGELES, CAL.—A. G. Gage is to be allowed the use of the city's proposed transmission line to obtain electrical energy from the Southern California Edison Company, in exchange for the right of way for the municipal transmission line across Gage's property near Saugus.

OROVILLE, CAL.—Work for the season has been stopped by the Oro Electric Corporation at Belden and men, who have been employed building roads from Belden to Yellow Creek, where work upon the $10,000,000 power plant of the company will be started early in the spring, have been laid off for the winter.

LOS ANGELES, CAL.—The special council committee appointed to open negotiations with certain power companies of the city for the acquisition by the city of portions of their systems for a municipal distributing system, will deal only with the Southern California Edison Company and the Los Angeles Gas & Electric Company. These two companies

have begun making appraisal of the systems for the purpose of making a settlement with the city.

QUINCY, CAL.—Three power companies are securing franchises in Plumas county. The supervisors have sold a franchise to the Indian Valley Electric Light & Power Company, which is operating in the northern part of the county. A. G. New, a San Francisco attorney, has made application for a franchise, as has the Oro Electric Company. The latter is building a plant at the mouth of Yellow Creek on the Feather River.

GRANTS PASS, ORE.—The California-Oregon Light & Power Company asked for a 40-year franchise for its system and service in this city, offering as an inducement two per cent of the gross revenues of the company within the city. The proposal was referred to a special committee, composed of the mayor and Councilmen Daniels and Clark, for investigation and report. The same committee is also investigating the proposition made by Geo. Sanders for supplying electricity to the city, the city to own the distributing system.

TRANSPORTATION.

EUGENE, ORE.—LaDeaux & LaDeaux, contractors, Portland, were awarded the contract for building the car repairing shop 35x135 ft. here for the Oregon Electric Company.

TWIN FALLS, IDAHO.—I. B. Berrine, this city, will build an electric line from this place to Shoshone Falls, Snake River a distance of ten miles. Edison storage battery cars will be used.

LEWISTON, IDAHO.—F. L. Strum, Wahpeton, N. D., has deposited $1,000 with the Lewiston Terminal Company as a guarantee that he will furnish electric railway service in the Lewiston-Clarkston valley in six months.

SALT LAKE CITY, UTAH.—That negotiations are on for the sale of the Salt Lake & Ogden Electric Railway to Eastern interests represented here by M. B. Hereley, a traction expert of Chicago, was admitted recently by Simon Bamberger, the president of the road. The deal, if consummated, will involve millions, and it is said by those interested that other millions will be forthcoming to extend the traction system north from Ogden and south from Salt Lake.

LOS ANGELES, CAL.—The council municipal railroad committee has recommended that plans be drawn for the municipal railway system from the city proper to the harbor, together with complete terminals in Los Angeles and a belt line at the harbor, also recommending that Engineer Franklin D. Howell of Los Angeles be employed to draw plans and prepare specifications in order that definite information may be secured so as to put a bond issue before the people in January.

OAKLAND, CAL.—Increased service has been started on the Hayward line during the rush hours of the evenings. Under the new schedule cars will leave Twelfth and Broadway under an average headway of a minute and 45 seconds between 4:57 p. m. and 6:10 p. m. for Elmhurst, San Leandro locals leave every five minutes and Hayward every ten minutes. The first Hayward limited leaves Oakland at 4:47 p. m. and others follow every 20 minutes until 5:57. Construction work is being rushed on the East Sixteenth line, which is expected to relieve congestion on E 14th street. One track is graded from the California Railway to Thirteenth avenue, and the other is being started.

LOS ANGELES, CAL.—The notice of sale for an operative franchise to the Pacific Electric on San Pedro street from Aliso street to 9th street over the proposed municipal railroad, was brought before the city council with the approval of the board of public utilities and action was deferred for a week. This was done in order to allow the Pacific Electric time to examine the plans for the proposed municipal line, completed Monday by the city engineer, and referred to the council by the board of public works. The engineer estimates the cost of the line at $208,540. Accompanying the plans is the form of contract for the construction of the line and inasmuch as the Pacific Electric will bid on the construction work, the officials desired time to examine the form of contract.

SAN FRANCISCO, CAL.—J. W. Riess, vice-president and general manager of the W. L. Holman Company, which has the contract for building the 43 cars needed for the Geary Street Municipal Railway, appeared again in the mayor's office Friday because the ten cars, promised for November 15, would not be ready for two weeks. Superintendent Cashin stated that when he should receive the first ten cars he would be able to establish service on the city's line from Thirty-third avenue to Kearny street, with a headway of about seven minutes. Commissioner Laumeister stated that all the material needed for the lower Market street extension was virtually on hand and that contracts would be let in about two weeks. The conference ended with instructions to Assistant City Attorney Havens to look into the question of whether or not the acceptance of ten cars would bar the city from proceedings against the building company's sureties to obtain damages for violation of contract.

TELEPHONE AND TELEGRAPH.

VALLEJO, CAL.—A direct telephone line between Vallejo and Green Valley will be installed by the city at once.

ALBANY, ORE.—The Home Telephone Company will install an inter-communicating telephone system in the First National bank here.

PRESCOTT, ARIZ.—The telephone system of the Mountain States Telephone Company is now in operation as far as Holbrook, and the extension of the line to St. Johns will be accomplished in the near future.

SPRAY, ORE.—The Spray Telephone Company is soliciting bids for stubbing of Heppner Canyon toll line from Monument Mountain to John Day. Bids received at Spray, Oregon.

DOUGLASS, ARIZ.—F. A. Secord, superintendent of telegraph on the El Paso & Southwestern, has set a crew of men to work stringing two copper wires from Tucson to Fairbanks and will put the line in the best possible service.

LOS ANGELES, CAL.—Bids will be received up to December 3d for the purchase of a franchise granting the right to erect poles, wires, conduits and other appliances for the transmission of electricity, for telephone and telegraph purposes.

OAKLAND, CAL.—Bids will be received up to December 2, 1912, for furnishing one combination central energy private branch exchange and police telephone and telegraph switchboard, set in place complete and ready for constant use in accordance with plans and specifications on file with the clerk.

SAN DIEGO, CAL.—Local officers of the Pacific Telephone & Telegraph Company have announced that a new switchboard of 12 positions will be installed in the San Diego exchange at the first of the year to take care of the rapidly increasing long distance traffic. It is claimed about $10,000 will be expended.

LOS ANGELES, CAL.—The Home Telephone Company of Pasadena, the new name under which the Pacific Telephone & Telegraph Company is operating since the merger of the two systems, plans extensive improvements, which among other things, will embrace the stringing of more than 100 miles of cable. It is estimated that the work will cost a quarter million dollars.

ALPHABETICAL INDEX TO ADVERTISERS

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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Where to Buy It in the West, Pages 9, 10. Alphabetical Index to Advertisers, Page 8.

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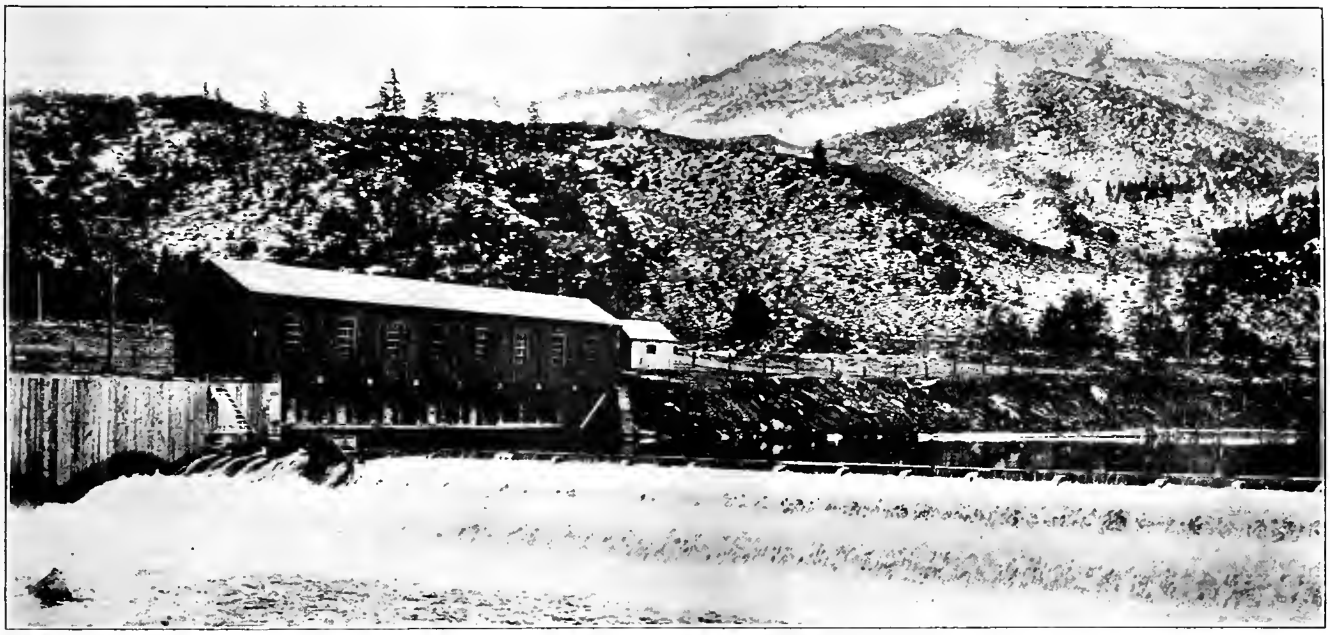


Diversion Dam and Headgates, Verdi Station

HYDROELECTRIC DEVELOPMENT AT VERDI

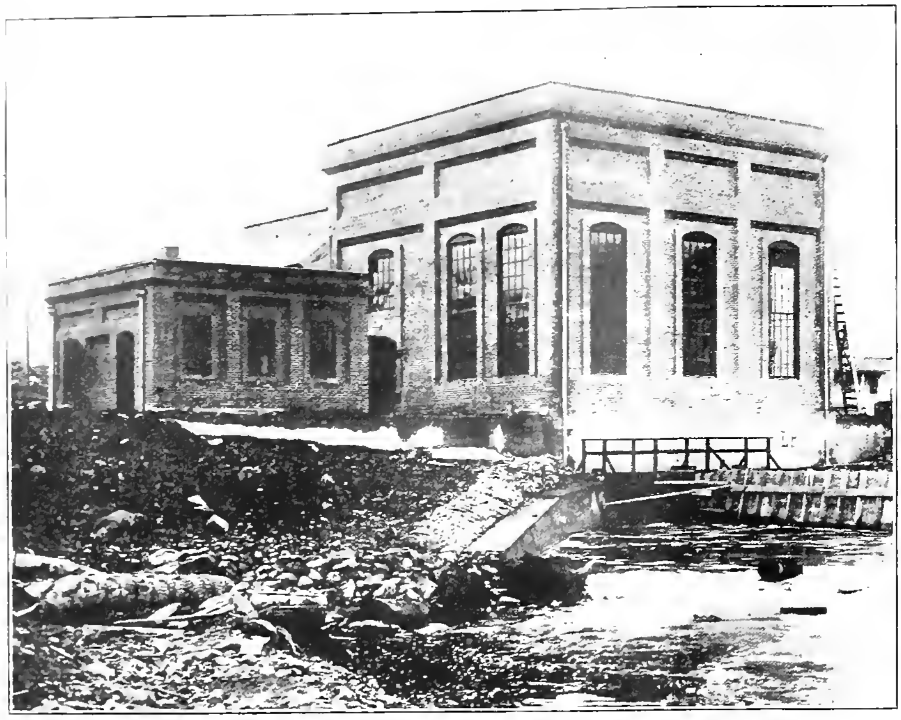
The construction of the Verdi development, the main hydroelectric station of which is located at Verdi, Nevada, represents a new accomplishment in difficulties overcome in transmission line construction. In addition to the main installation at Verdi the completed development consists of a dam across the Truckee River, a ditch, forebay, pressure pipe and its appurtenances, and finally a high-tension transmission line from the power station to Bluestone, via Washoe, Virginia City and Wabuska. This comprises a total distance in transmission of sixty-four miles.

In some features the construction of the transmission line is most interesting. The greater portion of it extends through an extremely rough country, making difficult the handling of materials and also the labor in their erection. On portions it was necessary to drag poles up long mountain sides by means of ropes and winches, and the transporting of small materials had to be done by hand or on mules. Most of the holes on the entire line were blasted from solid rock.

The pole line consists of two types of pole structure. The regular straight line structure is of two poles set vertically with a spacing of 12 ft. between their centers. The spacing of the poles and length of cross arms are such as to permit spacing the transmission line wires for operating at 104,000 volts. The average distance between these structures is about 400 ft. In the other type of structure four poles are used. These are placed in two pairs 12 ft. apart and each pair is erected with tops bolted together and butts 20 ft. apart, forming an inverted V.

The latter type is known as the "anchor structure," and is used at every half-mile in the straight line and at angles where it is necessary to hold the greater strain of the wires.

The power station is a brick building with steel frame, concrete floor and roof. The equipment in the station comprises a 2400 kilowatt generator driven by an Allis-Chalmers horizontal water wheel, two exciters, transformers for raising the voltage from that furnished by the generator to 60,000, which is required for the transmission line, switching equipment, lightning arresters and all necessary auxiliaries.



Power House and Tailrace.

Transmission Line.

In addition to the main station there are two houses, one for the chief operator and one for his assistant; also a shop and an oil storage and filter house, all of brick construction.

The pressure line consists of 790 ft. of steel pipe of 7½ ft. diameter at the power house end where the water pressure is the greatest, and 1430 ft. of wood stave pipe of 9 ft. diameter, between this section and the forebay. The pipe line is trenched and ballasted, with drains leading from it, and suitably located for disposing of seepage.

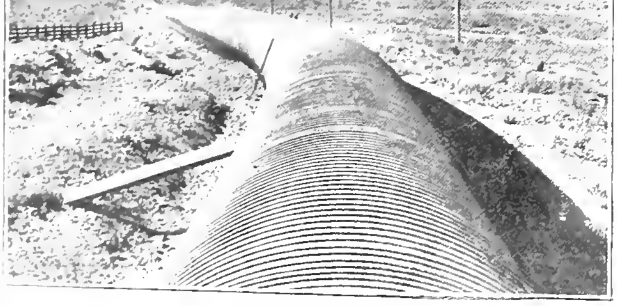
At the head of the pipe line are the forebay and flume of timber construction, which serve a double purpose; that of connecting the ditch with the pipe line and of making it possible, by use of gates, to obtain a closer control of the water admitted to the pipe. An overflow ditch leads from the forebay to the river for discharging excess water.

The main ditch is 10,200 ft. long and leads from the headgates at the dam to the flume and forebay. The earth in which the ditch was cut was heavily laden with large boulders, which caused difficult excavation and difficult work on embankments, and on considerable portions of it, formations of rock were encountered which required drilling and blasting. There was an equivalent of 205,000 cubic yards of earth removed in the excavation of the ditch.

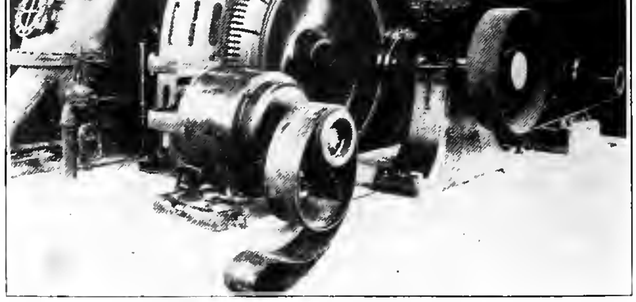
The cost of the work was originally estimated by Stone & Webster Engineering Corporation at $663,000. A small amount of additional work, aggregating some $6325, was later authorized. The actual total cost was approximately $676,300, or within about 1 per cent of the estimate.

The dam is of wood crib construction, with interior rock ballast and sheathed on the outside. The river bed is excavated to solid rock upon which the dam is built.

It was originally planned by rush work, with the



Wood Stave Pipe.



Power House Interior.

use of large forces and extra amount of equipment, to complete the entire development, so that by August 20th power could be delivered, but it became apparent later that the power would not be needed by that time, and besides the advantage of employing normal forces, it was found that it would be an advantage to postpone work on the dam until later when the water in the river would be lower. With the work conducted on this basis, the development so progressed that power was actually delivered, and the transmission line connected with the system of the Truckee River General Electric Company on November 3, 1911.

All work was not then entirely completed and the plant was not ready for permanent operation, but on account of a shut-down of the plant at Reno, the Verdi plant was kept in service about three weeks. The Verdi plant was placed in regular operating service on December 19, 1911, and the system was formally turned over to the Truckee River General Electric Company on December 23d.

PUTTING IT UP TO THE MAN.

How the wide-awake executive develops a sense of responsibility in the man below him and fits him to bear the burden of responsibility is entertainingly told by Glenn C. Webster of the Buckeye Electric Lamp Works in a recent number of "Business." The following paragraphs form the introduction to the story and illustrate how it should not be done:

The general manager of a concern which manufactured electrical parts rushed into his office, peeled off his coat, jammed his hat on a rack, and cast a hopeless glance at a pile of letters stacked on his desk. It was not an exceptionally busy day. Neglected papers, usually from three to four days old, always awaited his attention. Only by long and uninterrupted effort did he succeed in disposing of them. After a perplexed pause he called his superintendent.

"Macadam," said he, "I have an idea. It's an idea I've wanted to carry out for a long time, but these things"—indicating the papers on his desk—"are taking up more and more of my time. I've decided to turn the whole thing over to you. I know you will work it out in good shape."

Whereupon he unfolded his plan and commissioned Macadam to carry it out. The idea was a good one, the superintendent agreed. Even while his superior was discussing the job, he began to scheme. In his mind's eye, he saw how each detail could be performed; followed the steps in logical order and pictured the finished fabric. He was fired with enthusiasm. Here was a task that called for brains, a real man's task, a chance to test his dormant ability.

Macadam was a good superintendent and the manager knew it. They rarely disagreed on the necessity for changes or improvements, although their methods of procedure in making them were quite different. The manager was quick-witted, impulsive and imperative; Macadam, thoughtful, deliberate and capable. Just as Macadam turned the door-knob the manager called him back.

"I want this thing done according to my ideas," said he: and forthwith, he gave definite instructions which were to be followed.

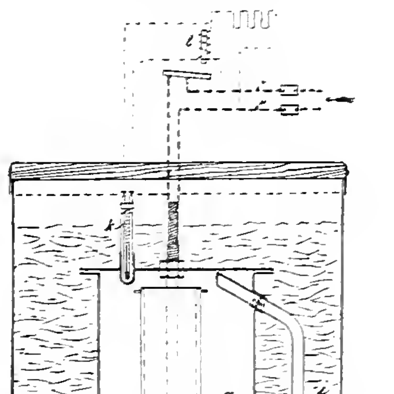
Unfortunately, the superintendent's mind had been started. His plans were just complete enough to interfere with the manager's, but not complete enough to form a working basis for the task as a whole. Neither of them realized it; yet the manager had jerked responsibility back upon himself like a ball at the end of a string. Back at his desk in the factory, the superintendent thought it all over. He did not know why; but his enthusiasm had chilled. He wanted to go back and argue it out, but the manager was invariably enveloped in an atmosphere of business that made interviews all but impossible; besides, interviews with the manager were monologues. He invariably did all the talking himself.

When the finished work was submitted, Macadam was not proud of it; nor was the manager pleased. It was the unsuccessful expression of two radically different minds.

EQUALIZING OF LOAD CURVES.

An attempt is being made on all sides to invent energy storing apparatus whereby energy generated in off-peak hours may be conserved to assist in hours of peak load. A foreign publication has recently set forth ideas of A. Rittershausen as follows:

The chief problem of central stations is to equalize the load curve and to encourage consumers to use energy during the daytime. This is possible only when the energy is stored in a form useful for domestic purposes, such as a hot-water storage apparatus of the type shown. The cold water enters at the bottom at



d; the hot water leaves at the top at e; c is a layer of infusorial earth which serves as a heat insulator. In order to make sure that hot water can always be drawn off from e, it is necessary that the cold water which enters through d shall not stir up the hot water above. For this reason the perforated plate f is provided. A definite circulation of the water is, however, necessary in order to heat the cold water. For this purpose the heating resistor g is surrounded by a cylinder h. The water within the cylinder is heated and rises, and cold water enters the cylinder from the bottom and so on.

READINESS TO SERVE METHODS

THE UTILITY VERSUS AGRICULTURAL SALES.

BY ROSS B. MATEER.

The awakening of the central station to the value of industrial power business was not sudden, but rather the result of pioneer work on the part of a few commercial engineers who dared to seek for business of a better load factor for the utility. Line extensions were grudgingly granted for power business, but generously allowed for residential lighting. Yet today the revenue accruing to central stations from the use of the electric motor is greatly in excess of that received from incandescent lighting.

A few lights operating for a short period of time at a high rate are not sufficient to warrant the use of the electric plant except from dusk until midnight. The industrial power load results in 24 hours a day continuous operation with an annual load factor of 50 per cent, which may be further increased to 70 or 75 per cent by encouraging agricultural uses for electricity.

Apparently few remember that the cities of large population today were the villages and hamlets of a few years ago and that the electric lighting station of the village was the nucleus of the many million dollar corporation and realize that with the expenditure of money for the extension of electric service into rural districts new towns will spring up and grow into cities, which in a few years will produce an annual revenue far in excess of the original investment. Pioneer work was needed in the past and is more in demand at this period for the development of the vast acreage of fertile land, which under irrigation will produce the wealth of a nation.

Will money be expended freely for such business as is to be secured in the populous centers and will the management of quasi-public utilities awake to the great possibilities in developing agricultural current sales, are the much-mooted questions of the day.

Many companies limit their investment in rural extensions by demanding that the entire sum be returned in current consumption in a year or two. Yet to attempt to construct lines and expect rural contracts to return the original investment in less than three years time and claim that a policy of this kind is pioneer development work is a fallacy and a direct evidence that a utility is not ready to serve its product at a moderate and fair rate sufficient to secure a just and reasonable sum on the original investment.

That liberal line extensions are needed for irrigation purposes, is evident when it is realized that only a small portion of our dry and at present fertile land is developed by the use of water from canals. The necessary flow must therefore be secured by pumping from the underground channels if agriculture is to be fostered in rural sections.

It has been stated that to judge a man, one must associate with him. Similarly, to pass an opinion on the land, its possibilities and needs, one must familiarize himself with the soil, not through an inspection trip at sixty miles an hour, but practical experience and the knowledge gained by those engaged in furthering current sales.

Sale Organization.

The development of agricultural current sales is best accomplished by the creation of an agricultural department of a central station with authority to promote the sales of current in rural sections by creating a market for current to be used for lighting, domestic, heating and power purposes. Such a department should be separate from all other utility activities and assume all responsibilities for the, sales of electric current in all rural sections, which comprise all lands not included in the incorporated limits of town or city.

The methods used in developing the business, the investigation of a prospective customer's needs, the recommendations on the proposed equipment and the supervision of the apparatus by periodical inspection, should all be under the control and direction of the manager in charge of this important revenue producing department.

Such a sales and engineering organization should consist of a manager in charge, a competent industrial engineer for investigating steam and internal combustion engine, operated installations, supplying such comparative data as may be required and for conducting tests as to the relative efficiencies of competitive apparatus. Sales engineers, those versed in dealing with the customer, should be used to obtain the confidence of the farmer, contracting for his business. Such salesmen should possess personality and a knowledge of the agriculturalist and his needs, convincing him of the advantages to be secured by the use of current.

For general information, a cabinet index of the apparatus in use and equipment contemplated is maintained in the general offices. Such data cards should show each year the current consumption of each installation, the acreage under cultivation, and the tonnage output in crops from which may be obtained comparative data for use in districts possessing similar soil and subject to the same climatic conditions. Data of this character is readily obtained at the close of each season and following an inspection of the apparatus.

It is possible for the central station to co-operate with the settler who has recently acquired land, giving suggestions as to the crops best suited to the land to be placed under cultivation.

In fact, "Readiness to Serve" on the part of the electric lighting company means full co-operation with the agriculturalist, taking a chance on the line extensions, if you please, and aiding to produce the wealth at present characteristic of the soil.

That such a policy is profitable both to farmer and utility and is productive of revenue, is evident from the examples quoted in succeeding papers. It is with the purpose of infusing new activity into the policy of some utilities now dormant, encouraging them to

reach out for a market for their product, expressing their willingness to serve current, establishing, if you will, a policy of co-operation with the farmer, resulting in the development of his land, and increasing the popularity of electric service that the attitude of the public utility is criticised.

JUSTIFICATION OF DEVIATIONS IN RATES FOR ELECTRIC SERVICE.

BY S. M. KENNEDY.[1]

There are two commodities handled by this company, gas and electricity, the production and distribution of which resemble each other in some respects, and are widely different in others. Each commodity is generated at a central plant, and delivered to consumers by means of suitable distributing systems—the one underground and the other mostly overhead. The amount of each commodity used by consumers is measured by meters set on the consumers' premises, and bills for service are usually presented and paid monthly. Just about this point the resemblance in handling the two products ceases.

We frequently hear the question asked by certain of the public, "Why cannot electricity be sold in the same manner as gas?"—that is, a flat price per unit of measurement. Now, there are several reasons why there must be different methods of charge, the principal reason pertaining to the method of generation. Gas may be manufactured at any suitable or convenient time of the day or night, and stored until the consumer desires to use it. Electricity cannot be stored (except to a very limited extent, and at great expense), and consequently must be manufactured the instant it is required. The generating capacity of a gas plant may be much less than the "peak" of the load, but the generating capacity of an electric plant must always be at least equal to the "peak."

We are in the habit of referring to a "service" of gas or electricity. Now "service" refers not only to the commodity supplied, but the availability of the supply. The extent of the service furnished any consumer consists in the quantity of gas or electricity consumed plus the amount of plant capacity maintained on his account and subject to his demand. But it will be noted that the generating capacity of a gas plant does not bear the same relation to each consumer's demand as does the generating capacity of an electric plant, the reason being that the former may be conveniently stored and the latter cannot.

There are three fundamental factors which must be considered as forming a basis in charging for electric service, namely, quantity, demand, and hours of use. It is in connection with the variation in these three factors, which different classes of service call for, that the apparent necessity for variations or deviations in rates enters into consideration.

The circumstances and conditions surrounding the supplying of electric service differ more or less in the case of each individual consumer. However, there are certain characteristics which are to a great extent constant in all installations in which the uses of the service are the same or very similar. Service for lighting is usually required during the night and the demand is largely influenced by the season of the year. Service for power is generally required during the daytime, and the demand continues fairly regular throughout the year, although our pumping load is heaviest during the summer months.

The intention of this paper is not to deal with the different methods of charging for lighting and power service. There has been much talk of so-called scientific rate schedules, which have been put into effect in various parts of the country, which schedules are supposed to automatically take care of variations in service conditions. In California the great demand from all directions is for a low maximum rate, and because of the wonderful diversity of the connected load of the Southern California Edison Company, a low maximum rate for lighting service has been made possible, but it cannot be said it has been arrived at scientifically.

In the lighting business there appears to be less necessity for deviations and variations than in the power business, because every one wants service during the hours of darkness, but, properly speaking, there are great differences in the values of various kinds of lighting loads. Take, for instance, a residence with, say, one hundred lamps installed. It seldom happens that more than fifteen or twenty of these lamps are in use at one time, and these only for an hour or two nightly, yet all of the hundred lamps may be in use at once two or three times each year. The average monthly consumption in this case is probably sixty kilowatt hours.

Now, then, let us look up the case of the little drug store " 'round the corner" from the residence aforementioned. It has an installation of only thirty lamps and uses twenty of them every night in the year until 11 o'clock. The average monthly consumption is 120 kilowatt hours, and the demand on the company's capacity less than one-third that of the residence.

Again, let us consider the big department store with two thousand lights installed, closing at 6 o'clock every business day. Its average monthly bills are no more than that poolroom near by, with less than two hundred lights burning every night until 12 o'clock. Then there is the church with its five hundred lights used once or twice a week. From the electric company's standpoint the little theater using one hundred lights every night is much better business, and undoubtedly the theater is entitled to a lower rate per kilowatt hour than the church for the energy used for illuminating purposes.

For lighting service, the quantity of energy consumed should not alone govern the rate per kilowatt hour. The demand each consumer is liable to make upon the company is of equal importance, and the relation of the kilowatt hours used to the maximum demand is what justifies deviations or variations in electric lighting rates.

We now turn our attention to the use of electric energy for power purposes, and here we find a greater number of variations in uses than in lighting, and these variations seem to be on the increase as the electrical business is developed. It will be remembered that originally central station plants supplied lighting service only; all through the daylight hours they stood idle, and the lighting income alone had to bear the

[1]General Agent, Southern California Edison Company.

entire fixed charges on the investment. The utilization of the investment for a greater proportion of the time became the problem and anxiety of electric companies, and as a consequence the power business was sought. It was argued that energy could be sold at lower rates if used only in the daytime, because the fixed charges would be practically the same, and the only additional expense would be operating costs. This was the first attempt at justification for deviations.

We all know how the power business has since developed, particularly in California, and that in our own company the kilowatt hour output is now five times greater for power service than for lighting. This large power business has been built up by the careful consideration of the three fundamental factors referred to—quantity, demand and hours of use.

Let us now consider the different classifications of power business and their relative value to the company in load building. They might be enumerated as follows:

FIRST. OPTIONAL SERVICE: Service that the consumer may take at any time of the twenty-four hours according to his necessity and convenience.

SECOND. DAYLIGHT SERVICE: This service covers such industrial business as takes power only through the ordinary working hours of the day, using no energy after 5 p. m.

THIRD. 20-HOUR SERVICE: Service used constantly except during the four hours of peak.

FOURTH. CONTINUOUS SERVICE: Service used every hour of the day, which means continuous use of a portion of the central station plant's capacity.

FIFTH. VALLEY SERVICE: Service which is used only between midnight and 6 a. m.

SIXTH. PUMPING SERVICE: Service usually taken for only six months during each year and used for pumping water for irrigation purposes.

SEVENTH: WHOLESALE SERVICE: Power service sold to other companies or to municipalities for resale.

EIGHTH. EMERGENCY SERVICE: Service used as "stand-by" to private electric, steam or gasoline plants.

In the foregoing classifications no reference has been made to the factor of demand, although it should properly enter into each, when the question of rates is under consideration. In other words, the more or less constant use of the connected load or maximum demand of each power customer, largely represents the value of each customer's business to the company. This is called the load factor. It is an axiom in the business that the higher the load factor, the lower should be the rate. This is the prime reason or justification for variation in rates for electric power service.

There are other reasons which contribute to the justification for deviations, such as proximity to point of generation, delivery of energy from high tension lines, consumer paying for line extension and substation equipment, temporary contracts for surplus water power, experimental work and other special conditions and circumstances unusual as far as the general service is concerned.

Rate-regulating bodies are now practically agreed that there may be discrimination in charging for electrice service as between the different classes of customers supplied, but that there shall be no discrimination betewen individual consumers of the same class.

In this connection information has been asked from some of our districts regarding the reasons for the different classifications in the existing power schedules of this company effective in territory outside of the City of Los Angeles.

What is termed the "standard power schedule" is on the block system, having eight divisions with a separate rate for each block. This applies to all power business not provided for in separate classes, and the service is unlimited as to hours of use. The deviations to the standard schedule are the following:

CLASS "A"—Pumping Plants. Because these pumping plants usually operate during the months when energy is used least for lighting purposes, and also because when in operation the load factor is usually good, and further because suitable guaranteed monthly mimimum payments are provided, the special rates are considered justifiable. In contracts under this class the company always reserves the right to discontinue service during four hours of "peak" daily.

CLASS "B"—Refrigeration, Rock Crushing, Brick Making and Woodworking. Each of these different industries usually gives a steady load while operating and the use of power is confined to the daylight hours. The special rates provided are protected with suitable monthly minimums.

CLASS "C"—Laundries. Contracts in this class are usually for auxiliary service. Laundries must have a steam installation to carry on their work and an electric service prevents additional steam installation as each laundry develops its business. The laundry load is steady and entirely off peak and the rates are protected by suitable minimums.

CLASS "D"—Cooking and Heating. This is given to encourage the use of electric cooking and heating for domestic purposes.

CLASS "E"—Provides for large installation and is now practically superseded by the schedule in Class "G."

CLASS "F"—Consumers using a large amount of power in the valley and no power on the peak. It is probable that a definite schedule for such service will shortly be prepared, as new conditions require that the rates be specifically stated.

CLASS "G'—Load Factor Schedule. This is really a wholesale schedule and open to all classes of power business. The minimum connected load to which it may apply is 75 horsepower and the minimum monthly bill must be equal to $2.00 per horsepower. The monthly rate per kilowatt-hour depends on the more or less continuous use of the connected load.

It will be remembered that we entered into a new era of regulation on March 23, 1912, when the State Railroad Commission took over the control of public utility rates, and that in this respect we are no longer a law unto ourselves. However, we do not anticipate any radical changes in the methods of charging for service heretofore adopted by this company.

ELECTRICAL PUMPING AND IRRIGATION

FORM OF CROSS SECTIONS OF CANALS.

BY B. A. ETCHEVERRY.

To determine the form of the cross section when the carrying capacity, grade and velocity are known the following factors must be determined:

1. Proportion of bed width to depth, or the desired bed width, or the depth.
2. Side slopes.
3. Top width of banks.
4. Height of top of banks above water line.
5. Desirability of berms.

These factors will be discussed under the following sub-headings:

a. The construction, lined or not lined.

b. The material through which it passes, sand, loam or rock.

c. The topography of the country, level ground or side hill.

d. The purpose for which the canal is intended, diversion line, main canal, lateral or farm ditch.

e. The volume of water to be carried.

f. The cost.

Canals in Earth Not Lined and in Level Country.

1st—Proportion of bed width to depth.

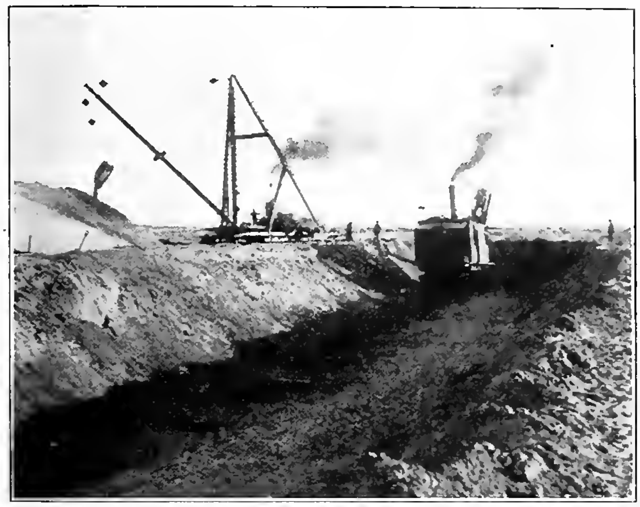
The relation between them is best illustrated by the following example. Three canal cross sections have been taken. They have the same carrying capacity, 300 cubic feet per second, and are under the same conditions. For all sections the grade is 4.5 ft. in 10,000 ft., the coefficient of roughness .025, the side slope 1 to 1, the width of the top of the bank 10 ft., and the height from the full supply water level to the top of the bank 2 ft. The first section is the one of least wetted perimeter, the second and third are shallower sections. The results obtained are:

Elements of canal section.	First Canal Section.	Second Canal Section.	Third Canal Section.
Base width in ft.	6.13	15.75	39.0
Water depth in ft.	7.40	5.00	3.00
Wetted perimeter in ft.	27.05	29.90	47.50
Area of water section in sq. ft.	100.00	103.75	126.0
Average velocity in ft. per second.	3.01	2.90	2.40
Depth of cut in ft. for balancing cut and fill	6.35	3.97	1.95
Height of fill in ft. for balancing cut and fill	3.05	3.03	3.05
Volume of cut in cu. ft. per lin. ft.	79.4	79.0	79.7
Height of water surface above original ground surface	1.05	1.02	1.05
Volume of water above original ground surface based on average velocity	41.2	60.0	104.50

(a) The above comparisons show that the wetted perimeter for the shallow sections, especially for section 3, is much greater than for the deep section having the best hydraulic elements. This increase in wetted perimeter will give a large seepage loss; on the other hand the smaller depth will tend to diminish the rate of seepage. The relative effect of each may be estimated as follows:

Let S = seepage per unity of length.
A = cross sectional area of waterway.
d = depth of water.
C = constant.
t:1 = side slopes.

If the intensity of seepage is proportional to the square root of the depth, then it can be represented by $C\sqrt{d}$. The average intensity of seepage on the sides is ½ the intensity on the base. Therefore the total

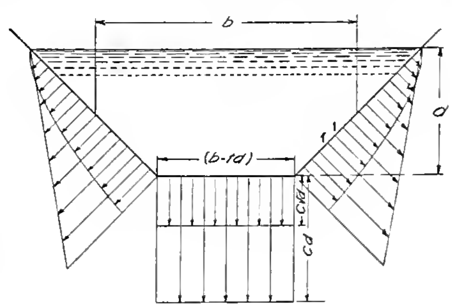


Steam Grader at Work—Truckee-Carson Project, Nevada.

seepage is equal to the base width multiplied by the intensity plus the length of the side multiplied by ½ the intensity on the base, or

For the canal sections assumed above we have:
Seepage for first canal section, S = 54.6 C
Seepage for second canal section, S = 56.3 C
Seepage for third canal section, S = 77.3 C

This would indicate that the seepage loss for the deep canal is less than for shallow canals. Based on the assumption that the intensity of seepage varies with the depth instead of with the square root of the



Absorption and Percolation Diagram

depth, the equation would then be $S = C\,(A + 0.41\,d^2)$, and the seepage for the above three cases would be 122 C, 144 C and 130 C. Based on this assumption the seepage would be least, not for the deepest section, but for a moderately deep section. No consideration was given to the temperature. The lower temperature

obtained in the deeper section would be an advantage in lowering the seepage losses.

(b) The area of water cross-section is least for the deeper section, consequently the area of excavation would be less for the deep section than for a shallower section when the canal is all in cut. However, the unit cost of excavation would be higher because of the greater depth and may increase the total cost. But even then, where the canal is to be lined with some expensive lining, such as concrete, the increased cost of excavation would probably be more than balanced by the decreased cost of lining a smaller wetted perimeter.

(c) The amount of excavation, when cut is equal to fill, seems to be nearly the same for all sections. The smaller unit cost of excavation for the shallow canals would make the shallow section more advantageous in this respect.

(d) The velocity for the deep section is higher and would produce a smaller seepage rate.

(e) The difference in elevation between the water surface and the ground surface is practically the same for all three sections, but this depth represents a greater volume of water with the wider section.

Excavating Farm Laterals With Fresno Scraper—Modesto Irrigation District, California.

The above deductions and theories as well as a number of other facts tend to show that of several sections, in level country with balancing cut and fill and under the same conditions of grade, carrying capacity, side slopes, top width of banks and coefficient of roughness, the section having the least wetted perimeter (or greatest hydraulic radius)is the most advantageous as regards cost of lining, volume (but not necessarily cost) of excavation, and velocity. These advantages would make this section preferable for a lined canal or a canal in rock. On the other hand the disadvantages are (1) decrease in safety, especially when the canal is in fill which is very desirable for laterals and farm ditches; (2) difficulty in maintaining side slopes in a deep canal requiring flatter slope than for a shallow canal or the use of berms; (3) smaller proportion of the total volume of water held above the ground surface, making diversion into laterals or application to the land more difficult; (4) difficulty in excavating deep canals with ordinary methods of canal excavation.

The above relations have been deduced from canals under the same condition for grade. It often happens, however, that it is desired to use a fixed velocity in which case for a given carrying capacity the area of cross section would be the same and the grades would be computed accordingly. The section of least wetted perimeter would then require a smaller grade but would give a larger amount of excavation for a balancing cut and fill section in level country.

For these reasons the form giving best hydraulic elements is rarely used for irrigation canals, except where the canal is on side hill, or is lined, or in hard material expensive to excavate. The above examples show that the wetted perimeter is not much greater when the canal is not excessively wide and that the seepage may be less for a moderately deep canal than for a very shallow or very deep canal. The practice has been to adopt excessively shallow canals; while this may be necessary and desirable for the distribution system, it is not usually economical for the diversion canals, where a moderately deep canal is best. The proportion of bed width to depth varies greatly with the ideas of engineers. The following empirical rules represent good engineering practice for ordinary main canals in earth.

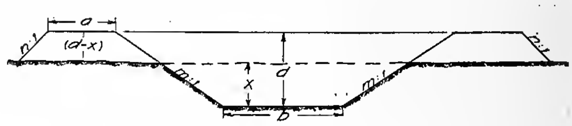
First empirical rule.

Carrying Capacity.	Make Depth in Feet.
1,000 to 1,500 second ft.	6 to 9
750 to 1,000 second ft.	4 to 8
400 to 750 second ft.	3 to 6
300 to 400 second ft.	3 to 5½
200 to 300 second ft.	3 to 5
100 to 200 second ft.	2½ to 4½
100 or less second ft.	2 to 3½

Second empirical rule.

Carrying Capacity.	Make Width.
1400 second ft.	Not less than 5 x depth
1000 second ft.	Not less than 4 x depth
500 second ft.	Not less than 3 x depth
300 second ft.	Not less than 2 x depth

F. W. Hanna, Project Engineer for the Payette-Boise project, U. S. Reclamation Service, recommends the following proportions of bed width (b) to depth



Typical Illustration for Determination of Cross-section and Side Slopes of Ditch

(d) for laterals of the distribution system: $b = d^2 + 1$, where the fall is slight, and $b = 2d^2 + 2$, where the fall is abundant.

2d. Side slopes.

The correct inside slopes of a canal depend mainly on the character of the material. The inside slopes generally used are: for loose sandy soil, 2 horizontally to 1 vertically; ordinary sandy loam, 1.5 horizontally to 1 vertically; ordinary firm soil, 1 horizontally to 1 vertically; hardpan or very firm soil, ¾ or ½ horizontally to 1 vertically; solid rock, ¼ horizontally

to 1 vertically. The section with the smallest area of water way for a given grade has side slopes of about .6 horizontally to 1 vertically. To facilitate excavation and diminish the cost of construction, the canal is frequently given side slopes of 1½ to 1, or 2 to 1, and the bottom and corners are slightly curved giving the section the form of the segment of an ellipse. This is usually the case for laterals and farm ditches in ordinary earth excavated with Fresno scrapers. The outside slopes of an embankment are usually 1½ to 1 and may be as flat as 2 to 1 for very loose sandy soil.

3d. Top width of banks.

For main canals and main laterals, the top of the bank is often used as a private roadway for ditch tenders' carts, in which case the width must be not less than eight feet. If not used for a roadway, the width to be given will depend on the size of the canal and on the soil, on the depth of water, especially on the proportion of the depth in fill, and on the importance of preventing a break.

For Canals with Carrying Capacity of	Top Width Should Be
1500 second ft.	Not less than 10 ft.
1000 second ft.	Not less than 8 ft.
500 second ft.	Not less than 7 ft.
300 second ft.	Not less than 6 ft.
200 second ft.	Not less than 5 ft.

A general empirical rule would be: Top width = Depth of water + 2.

For distribution laterals: Top width = Depth of water, with a minimum of 3 feet.

4th. Height of top of banks above water surface.

The following heights are generally used: for large deep canals a maximum height of 3 ft.; for main laterals a height of 2 ft.; for smaller laterals carrying 50 to 100 cu. ft. per second, a height of 2 ft. to 1½ ft. For canals carrying 50 cu. ft. per second or less, a height of 1 ft. There is no advantage in more than this. If stronger banks are necessary, the extra material can be used to better advantage by increasing the width and not the height.

Steam Shovel Excavation—White Valley Irrigation System, British Columbia.

5th. Desirability of berms.

Berms are not commonly used in irrigation canals. Their use is justified in deep cuts where the surcharge of the earth above the water line may cause caving. For deep canals when the channel is partly in cut and partly in fill a berm from 2 to 6 ft. wide is sometimes left between the top of the bank in cut and the bottom of the fill. In deep cutting where the excavated material is run to waste, a berm of 6 to 10 ft. wide should be left between the top of the cut and the bottom of the waste bank slope.

Side Hill Sections.

Proportion of bed width to depth.

Where the section is in rock or in firm soil, the canal section should approach as much as practical the section with the best hydraulic elements.

Depth of water in canal.

To insure against breaks, it is very important in side hill work, especially steep side hills, that at least two-thirds of the depth of water be in cut. If a larger proportion is in fill the breaks will be greater and more frequent and the necessary repairs and vigilance are expensive.

Side slopes.

The side slope on the mountain side or cut side can generally be made steeper than on the fill side; for canals in ordinary firm side hill soil the side slopes commonly used are 1 to 1 on the uphill side and 1½ to 1 on the down hill side.

THE PUBLIC AND PUBLIC SERVICE CORPORATIONS.

BY F. K. BLUE.

Since it is a monopoly, the income on investment in a public service corporation depends entirely on the charges for service under given conditions of custom and operation. It is of great economic advantage to have such utilities for a given service handled by no more than one organization in each municipality or district, but if the rates are fixed in the interest of the investment only, they will bear no relation to cost of production and allow the consumer no advantage from economy of operation. It is desirable, therefore, for the public to discourage the uneconomical condition of competition, but to require such methods of fixing rates that they shall conform to those that would normally result under competitive conditions.

To do this it is necessary to follow arbitrarily the principles by which prices are established in normal competitive production. The paramount condition for the development of an industry is that the returns must be sufficient to induce workmen to do the work and capitalists to provide the equipment. At this point prices will correspond with those established by normal competition and will allow no fictitious valuation of investment. They will then conform to the normal cost of production.

To make the rates of public service corporations arbitrarily correspond with those established under normal competition it is necessary then to conform as closely as possible to the following principles:

(1) A policy and agreement with public service corporations should be established that will provide an acceptable return to investors in the securities of the corporation but which will not produce a material change in the value of such securities on account of the rates for service that are allowed.

(2) Provision should be made that earnings shall finally depend on definite service rates previously fixed, to continue throughout stated intervals of time—conveniently, one year.

(3) The value of securities depends not only upon present returns but upon prospective future returns. So that when future income is likely to vary, then the value of the security will not correspond with the present rate of return, but will be the present value of all estimated future returns. The probability of future losses must also be discounted by larger returns in the present and early losses and costs must be provided for by greater dividends in the future. It may often be more desirable for the consumer to assume some of the risks of the uncertain future than to pay the higher rates required when they are all borne by the stockholders. So in order to command a low rate of return on an investment it may usually be desirable to reduce its speculative character as far as possible by providing for an extension of franchise until all capital and income agreed upon has been returned to the investor or purchased by the municipality at a valuation provided by the terms of the franchise. The investment return ought then to approach the rate of interest on the value of the bonds of the same corporation.

Principles Applied in Automatic Method of Rate Fixing.

A method of rate fixing based on the actual returns on the market value of the stock of a public service corporation may be provided which will automatically hold its dividends to a rate which is acceptable to the original and all future investors in the stock and which will prevent its market value from varying greatly from the actual original investment or the physical valuation including legitimate intangible values. This method will secure to the consumer all the economic advantages of monopoly and also rates for service conforming to these that would be established under normal competition.

Until a public utility is built up to a paying basis at reasonable rates for service, expedients for deferring dividends must be carried out, but when finally established the principle of the operation of this method may be roughly outlined as follows:

The physical valuation of the properties of the corporation is assumed to be established to correspond to the actual legitimate investment upon which the stockholders are entitled to receive dividends. This valuation will be altered for purchases and sales of properties and changes in the value of real estate in service and gold.

For convenience the par value of all outstanding securities should correspond with the physical valuation of the properties.

To fix the rates for any given year the probable operating expenses should be estimated from the actual expenses during previous years according to definite methods stated in the terms of the franchise and conforming to the nature of the utility. This should include all charges except dividends and any sums that may be set aside to the credit of the city.

To the above amount should be added a sum which would make the probable rate of return on the physical valuation of the properties equal to what was the rate represented by the actual amount credited to stockholders during the previous year relative to the average value of the outstanding stock during the previous year as represented by the market quotations of prices asked. A provision must of course be made that the stock must not be withdrawn from the market.

Based on the revenues of previous years and according to definite methods stated in the franchise a nominal rate of service should be estimated to provide a probable revenue equal to the operating expenses and dividends to stockholders as estimated above.

The actual rates for service may be fixed at a higher point if it is desired to apply the difference towards the accumulation of a fund to be placed to the credit of the city for the purchase of the utility from the corporation.

This method of rate fixing would act like a relay governor in mechanics, the economic forces interacting in such a manner that any variation from the normal would be met by an opposing force which would tend always to bring the relations to a stable equilibrium at the point where the value of outstanding securities would equal the physical value of the properties and the return on the investment would equal that which an owner of stock would just be willing to forfeit by its sale.

When this method of rate fixing is followed the speculative value of the stock of the corporation will be confined to the possible increase or decrease in earnings during the year. The exact amount of this return also depends upon economy of operation and management during the year as it ought to do.

The method of fixing charges for service being defined by the terms of the franchise, disputes between the city and the corporations would be avoided, and the return on the investment being actually determined by the investors at their own rates, the grounds for contesting such rates on account of confiscation of property would be removed.

Similar methods are applicable to the regulation of prices in case it is decided to establish government control of trusts instead of attempting to hold prices to cost of production by restoring competitive conditions.

Legislation Required to Put Such Principles in Practice.

In order to apply modern methods of franchise adjustment and rate fixing in San Francisco, it has been found necessary to provide amendments to the charter which will allow franchises to be granted upon terms which investors can afford to accept and yet which will also safeguard the interests of the public. The present charter requires such onerous conditions in regard to term of franchise and share of gross revenue that must be paid to the city that investors in street car lines cannot hope to get an acceptable rate of return on investment and also have their capital returned before the term expires. By the proposed amendment, No. 34, to be voted on December 10th, these matters are provided for, so that the city will be able to grant franchises which will be acceptable to investors and yet which will not allow a valuation of the properties of the enterprise above that represented by real and legitimate investment.

SCIENTIFIC PLANT MANAGEMENT

FUNDAMENTALS OF FUEL TESTING—SPECIFIC GRAVITY.

BY J. P. ZIPF.

The complete analysis of a western boiler test requires a knowledge of the oil used as fuel. An average sample having been obtained, further investigation is best carried out in a laboratory equipped for this purpose.

The specific gravity is conveniently determined on a Westphal balance as shown in Fig. 2. This consists of a balance arm supported on knife edges, from one end of which is hung a glass bulb, the other end being counter weighted. Along the balance arm are nine notches, the hook supporting the glass bulb being in the position of the tenth notch. The glass bob has a displacement of exactly 5 gms. of pure water at 4 degrees centigrade. Hence if the bulb were so immersed, a 5 gm. weight would establish equilibrium if hung from the hook. This would indicate a sp. gr. of 1.0000.

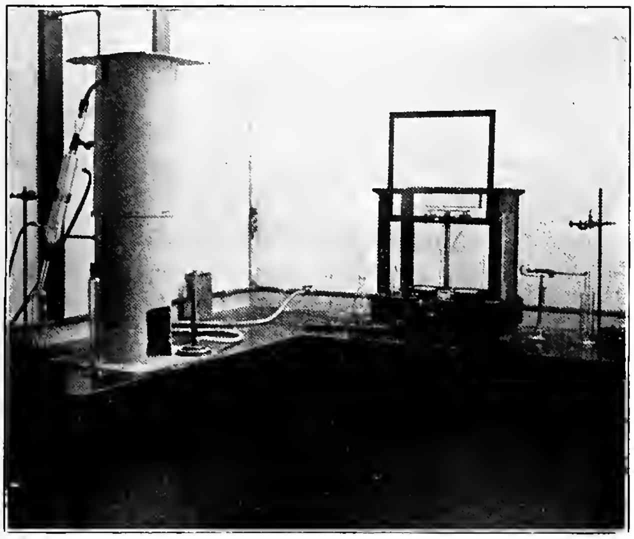


Fig. 1. Complete Laboratory Equipment for Fuel Testing.

Adjustment consists in tilting the balance arm support by turning a thumbscrew, forming one point of a three-point support, until the pointers are opposite each other, the bob being unimmersed. For specific gravities less than 1.0000 the 5 gm. rider (called the "unit-weight") is hung in a notch such that equilibrium is nearly reached, but not exceeded. This gives the first decimal place. The 1/10, 1/100 and 1/1000 unit weights are hung respectively in notches so that equilibrium is finally established. The specific gravity is then read directly to four decimal places by noting the notches in which the riders hang, commencing with the largest rider.

The oil sample should be allowed to stand in the laboratory several hours before determinations are made, in order that any drops of water in the oil may settle. A small quanity is then poured from the sample can into a suitable glass jar. The Westphal balance, having been dusted with a soft brush, is adjusted to equilibrium and the specific gravity of the sample obtained, together with its temperature.

As specific gravity is usually referred to a temperature of 60 degrees F., another determination must be made at a temperature differing by 15 degrees F. to 20 degrees F. from the first. The temperature of the sample in the jar may be raised by immersion in a water bath, great care being taken to allow no water to get into the oil. For example let us consider an oil, two determinations of which are:

The specific gravity (S_1), 0.9582 at a temp. (t_1) of 68.9° F.

The specific gravity (S_2), 0.9525 at a temp. (t_2) of 86.5° F.

Fig. 2. Westphal Balance for Determining Specific Gravity of Oil.

$$\frac{(S_1 - S_2)}{(t_1 - t_2)}$$ is the change in sp. gr. for 1° F.,

over the range t_1 to t_2. This change in specific gravity for 1° F. is the coefficient of expansion of the oil. Thus in this case the coefficient of expansion is

$$\frac{.9582 - .9525 = .0057}{68.9 - 86.5 \quad -17.6} = -.000324 = C$$

The coefficient of expansion will vary with different oils from —.00027 to —.00042.

Then at 60° F. the gravity will be

$$S_1 + C\ (60 - t_1) \text{ or } S_{60} = .9582 + [-.000324\ (-8.9)\ ] = .9610.$$

The oil is referred to the Baume scale by the formula

$$B = \frac{140}{\text{sp. gr.}} - 130$$

This oil then, has a gravity of 15.68° B.

The oil in the glass jar should be poured back into the container. The bob is cleaned by immersing in benzene and wiping dry, and the glass jar by simply wiping free from oil.

THE ROSEBERRY LAW AND WORKMEN'S COMPENSATION.[1]

BY W. A. CHOWEN.

In order to more fully understand and appreciate the Roseberry Law, let us first briefly review the conditions which surrounded the recovery for occupational injuries under common law as they existed prior to the enactment of the Roseberry Law.

The master was liable for injuries to his employees,

(1) Caused through the wrongful act, neglect or default of himself or a vice-principal, i. e., foreman or superintendent in his employ;

(2) Caused by machinery which was out of repair or unsuited for the use for which it was provided;

(3) Caused by his failure to provide a safe place or appliances for his employees' use; or

(4) Caused by his failure to properly warn or instruct his employees of dangers which were not patent or apparent.

On the other hand, no recovery could be had in cases where the injury was caused by a fellow employee of the injured.

Or where the carelessness of the injured party was the contributing cause of the accident.

Or where the accident arose out of the usual hazard of the business or work engaged in.

There seemed to be great reasonableness and justice in this order of things, that if the accident was caused by the master or his vice-principal or by reason of defeotive or unsuitable machinery or failure to provide a proper place for his employees to work, he should be called upon to make reparation, so far as possible, by financial contribution in terms of lost wages, medical expense, and, in exaggerated cases, for pain and suffering.

Also it seemed reasonable that the master should not compensate for loss by reason of the injured's own carelessness or the carelessness of a fellow servant or by reason of the inherent dangers of his occupation. Obviously, a man injured by his own carelessness should himself suffer the consequences; again, a fellow workman would be responsible for causing injury by his carelessness, and there would be a cause of action against him, but not against the master, and, lastly, no occupation can possibly be made absolutely free from danger, and so the compensation received from any given occupation was held to cover the risk dependent upon that occupation.

Clearly, then, under this arrangement of things there were many injuries sustained by workmen for which there was no recovery from the masters under common law. This being true, it not infrequently happened that employees suffered the loss of an arm or a leg or an eye, or life itself, and there being no right of recovery as against the master, were left as a public charge. Not only themselves, but all too frequently their families were left thus destitute. In other words, to use a favorite expression of Mr. Pillsbury, chairman of the Industrial Accident Board, "they were thrown below the poverty line." It was to relieve this condition among those engaged in the so-called "hazardous employments" that the system of compensation for occupational injuries was provided.

A system of compensation for occupational injuries and illnesses has been for some time in vogue in many European countries. It has been contemplated by various and several of the States in the United States for some years past, and the principal reason why it has not been sooner put into effect in America is because of the theory that to impose upon the industries of one State an obligation to reward employees for all occupational disabilities, regardless of the question of responsibility of the master, would be placing a handicap over the industries of one State as compared to those of a sister State which were not so burdened.

Regardless of the theoretical handicap which I have mentioned, several of the States have recently enacted compensation laws. These laws are quite similar in many respects, as having been designed to effect the same results, i. e. to relieve society in general from the charge of the permanently disabled, and to attach to each individual industry its proportion of the burdens due to accidents; a further theory being that to thus throw the burden of its industrial loss on each branch of industry will reduce the shock, as it were, and cause it finally to become an overhead charge against the production of that industry, eventually to be borne by society in general.

The Roseberry Law, which was enacted in California, and took effect September 1, 1911, was, I understand, very largely taken from the compensation law in force in Wisconsin. Our law provides that it is optional with the employer to elect whether or not he will be governed, in his treatment of the injuries sustained by his employees, by the so-called "compensation features" of the law. If he elects to be so governed he must give written notice to a body of men known as the Industrial Accident Board, which board consists of three members, appointed by the governor, with offices in San Francisco.

This notice must also be posted conspicuously throughout his place of business, and also placed on records, in order that whoever may be concerned will be able to determine whether or not he has made this election.

Having given this notice, the employer will be considered as being governed by the compensation features of the law from the date of the filing of the statement and thereafter, without further act on his part, for successive terms of one year each, unless he shall, at least sixty days prior to the expiration of such first or any succeeding year, file a notice in writing to the effect that he withdraws his election to be subject to the provisions of the act.

It then rests with his employees to be governed by the compensation features of the law, provided the master has elected, unless they in turn serve written notice upon the employer within thirty days of the date on which he gives such notice or date of his employment. Failing to give such written notice to the employer, the employee must then abide by the terms of compensation provided by the Roseberry Law, and cannot receive a greater sum for any given injury or disability than that provided in the law, except that when the injury was caused by the personal gross negligence or wilful personal misconduct of the employer or by reason of his violation of any statute designed for the protection of employees from bodily injury, in which event the employee may either claim compensation under the act or maintain an action for damages under common law.

In the event of the employer failing to give such notice of his intention to be governed by the compensation features of the law, he is then subject to the terms of common law governing actions for personal injuries, but the Roseberry Act provides further that should the employer not elect to take advantage of the compensation features by giving notice as herein outlined, then he shall be subject to common law, and it shall not be a defense:

(1) That the employee either expressly or impliedly assumed the risk of the hazard complained of.

(2) That the injury or death was caused in whole or in part by the want of ordinary or reasonable care of a fellow-servant.

(3) The fact that such employee may have been guilty of contributory negligence shall not bar a recovery therein where his contributory negligence was slight, and that of the employer was gross in comparison, but damages may be diminished by the jury in proportion to the negligence attributable to such employee.

[1] Address before Electrical Development League, San Francisco, November 12, 1912.

In other words, the doctrines of negligence of fellow-servant and assumption of risk are expunged, and the question of comparative negligence is left for the jury.

It is a little difficult to say exactly what percentage of cases are governed by these three rules, but the Industrial Accident Board, which has given the question very serious consideration for a number of months, has come to the conclusion that the obligation of the employer has increased approximately 400 per cent by reason of the elimination of these three defenses as compared to similar actions at common law under the conditions as outlined in the opening of this paper.

Among employees who are covered by this law are included aliens and also minors who are legally permitted to work under the laws of the State. The act also expressly states that any person whose employment is but casual and not in the usual course of the trade, business, profession or occupation of his employer is not included under the compensation features. Just who is included under this latter classification, however, has not yet been fully decided. It is given as the opinion of the Industrial Accident Board that this means domestic servants, for instance, as these servants are not employed in the course of the trade, business, profession or occupation of the employer.

The compensations provided by the act are such medical and surgical treatment, medicines, medical and surgical supplies, crutches and apparatus, as may be reasonably required at the time of the injury and thereafter during the disability, but not exceeding ninety days, to cure and relieve from the effects of the injury or the furnishing of such treatment and appliances not to exceed the sum of $100.

For total disability, 65 per cent of the average weekly earnings, provided the disability shall have lasted seven days, in which event compensation shall be paid for the first week's disability, but the total of such compensation shall not exceed three times the average annual earnings.

If the disability is partial, then 65 per cent of the weekly loss in wages shall be paid.

The period for paying compensation shall not extend beyond 15 years, which it might do in the event of slight permanent partial disability.

In the event of death, compensation shall be paid to the legal heirs, which, together with the compensation already paid (if death is not immediate) shall equal, but not exceed, an amount equal to three years' wages, which amount shall not be less than $1000 or more than $5000.

It must be borne in mind that this death benefit must be paid in the event of death occurring any time within a period of 15 years where the accident was the approximate cause of death within said period.

In the event of there being no dependents, the amount of indemnity collectible from the employer shall be $100 to defray funeral expenses.

The law also goes into detail as to the manner of computing these compensations, and also as to who shall be considered dependents, and as to the prior right of such dependents in accordance with the degree of relationship to the injured employee.

The law further requires that the employee shall submit to physical examination from time to time when required to do so by his employer, and in the event of his refusal to submit to such examination, his compensation shall cease, unless and until he shall have submitted to the physical examination. The Industrial Accident Board is also given the right to ask for physical examination in case the matter of the adjustment of the claim is placed before them for a decision.

The law also provides for the manner of settlement of disputes of any of these claims, which settlements shall be left with the Industrial Accident Board, and their action shall be final, and can only be set aside upon the grounds,

(1) That the board acted without or in excess of its powers.

(2) That the award was procured by fraud.

(3) That the findings of fact by the board do not support the award.

Upon the setting aside of any award by the Industrial Accident Board the court may recommit the controversy and remand the record in the case to the board for further hearing or proceedings, or it may enter the proper judgment upon the findings, as the nature of the case shall demand.

The law further provides that no claim for compensation under the act shall be assignable before payment, nor shall any claim for compensation, or compensation awarded, adjudged or paid, be subject to be taken for the debts of the party entitled thereto.

Permission is given by this law for the compromise or settlement of any claim that may arise under the act. In other words, in the event of the agreement of the employer and his injured employee, an anticipatory settlement may be entered into at any time prior to the termination of disability.

In order to collect the compensations due under the compensation features of the law it is necessary for the injured employee to give written notice to his employer within 30 days of the time of the accident.

This is a brief resume of the conditions which surrounded the recovery for occupation injuries prior to the enactment of the Roseberry Law, and also an outline of the principal provisions of that law.

So much for the past and the present; what of the future?

At a special election held October 10, 1911, the people of California adopted the following amendment to the constitution of the State:

> The legislature may by appropriate legislation create and enforce a liability on the part of all employers to compensate their employees for any injury incurred by the said employees in the course of their employment, irrespective of the fault of either party. The legislature may provide for the settlement of any disputes arising under the legislation contemplated by this section, by arbitration, or by an industrial accident board, by the courts, or by either, any or all of these agencies, anything in this constitution to the contrary notwithstanding.

Only yesterday I received a circular letter from the Industrial Accident Board, calling attention to the fact that the subject of compulsory compensation for all employers will come before the next Legislature; also inclosing a pamphlet entitled "Memorandum Concerning a Proposed Scale of Compensation Benefits to Be Paid to Workmen Injured Through Industrial Accident."

If the theory upon which compensation for occupation injuries is based, i. e., that each industry should carry its own burdens, is correct—and I believe it is—then it is just and proper that a system of compensation should be calculated to apply to all branches of industries indiscriminately. In other words, compensation should be compulsory. Since, however, the basic principle upon which the theory of compensation rests is to relieve society of the physical derelicts caused through occupational injuries, it should follow that for a simple and temporary injury the compensation should be nil, or, at least, slight, as compared to total permanent disability or death, and no compensation should be paid for disability covering any period of, say, less than 30 days.

Practically all of the European countries, and many of the states of the United States, have enacted laws governing the adoption of safety appliances on all dangerous machinery. California, much to her discredit, has no such law. Our failure to adopt such a law in the face of our having placed a compensation act on our statute books is, to use a rude example, about as consistent as to wear hob-nailed shoes with a dress suit, or the construction of a hospital at the base of a cliff over which we are driving our inhabitants. As a practical expression of what a safety appliance law means I should say that in the State of New Jersey, under a compensation law very similar to that of California, we accept on an average 25 per cent less premium for liability insurance on any given line of industry than that accepted in California, owing to the fact that New Jersey has a strictly enforced safety appliance law, and California has none.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

No union can ever be lasting wherein each party to the contract does not receive a material benefit.

Accident and Pension Funds

Philosophers may ruminate and social service reformers decry the times, yet the evils to be corrected are only perfectly adjusted by synchronizing the internal attitude of all parties into a harmonious unit rather than attempting to generate a singleness of purpose by methods of enforced tolerance. No truer saying than this can be applied to the fundamental steps necessary in the upbuilding of esprit de corps in the modern public utility company.

The beginning of the new year will witness the putting into effect of the greatest humanitarian movement looking toward material and social betterment of wage-earners ever attempted by a public utility—in fact—by any corporation. Hitherto, previous establishments on a large scale, of funds for accident and pension purposes, have always had some proviso or requirement which many have seen fit to criticize. The United States Steel Corporation, for instance, provides that its employes may buy its preferred and common stock annually below the market price, and pay for it in five yearly installments from wages earned, while effective, nevertheless, some have scented in this an ulterior motive. The scheme of the American Telephone & Telegraph Company, however, strikes boldly and fearlessly into the true concept of old-age pensions and accident funds. This company has made provision for a $10,000,000 pension fund, in which nearly 175,000 workers will participate. Indeed this message carries a new year's benediction from over thirteen thousand Pacific Coast workers. Faithful employes, superannuated in service, may retire on the new pension plan and the untimely accident is to be met by a welcome fund for the helpless dependents or suffering employe.

For all these benefits the employe pays not a cent. This movement of a great corporation is not to be welcomed as that of a philanthropist or of a Daniel, come to judgment. Rather is it the fruits of the foresight and broad-minded business policy of the leaders of a great corporation. Under this new regime, the employe is not to pay the bill nor is the employer, but rightfully is the cost of service to bear the burden of all, that in justice to human rights, it should. Compensation is, first of all, founded in that social justice which demands that each industry shall so take care of its own killed and wounded, and those dependent upon them, that they shall not, as a result of industrial accident, become public charges. But this great movement on the part of the Bell company goes further than merely taking care of the killed and wounded. It proposes to care for those who in the winter of life, as years of faithful devoted service roll by, still remain with us for a season, to live again in thoughtful reflection those years of busy activities in service of the utility.

The great movement in recent years aiming at regulation of public utilities has resulted in a material cutting of former gigantic returns. The cry of the day is to determine the cost of service. The courts have universally recognized the fundamental principles involved in depreciation and obsolescence accounts, and in maintenance and operation of inanimate ma-

chinery. That there is a costly account chargeable to maintenance and operation, due to the human element, is undeniable. Statistics show that industry in the United States kills somewhere between 30,000 and 50,000 persons each year, cripples more or less seriously 500,000 and injures in the neighborhood of 2,000,000 sufficiently to cause them to lose time from work. Again, a necessity for depreciation and obsolescence accounts due to the human factor, though thus far neglected in the expert's inventory of sinking funds, truly exists as a fundamental postulate in order to attain maximum service at minimum cost. For the level-headed farsightedness involved in thus boldly putting into practical operation this humanistic principle, the public stands indebted to the Bell company. This worthy effort deserves the hearty support and communication of all.

The Minimun Charge in Arizona

In the weights and measures law, which was passed by the 1912 legislature of Arizona, it was made unlawful for any company to charge for water, electrical energy, or illuminating gas except by meter measurement, if the consumer request that the same be sold to him by meter measurement.

It is interesting to note how some of the companies have attempted to meet this illogical requirement. The Nogales municipal plant, for instance, has instituted the following complicated and unsatisfactory rate in its water charges:

150 gallons per month at	$ .01	per gallon	$1.50
300 gallons per month at	.00533	per gallon	1.60
500 gallons per month at	.0034	per gallon	1.70
1000 gallons per month at	1.85	per 1000 gallons	1.85
1500 gallons per month at	1.33 1-3	per 1000 gallons	2.00
2000 gallons per month at	1.07½	per 1000 gallons	2.15
2500 gallons per month at	.92	per 1000 gallons	1.30
8000 gallons per month at	.81 2-3	per 1000 gallons	2.45

and so on up to 30,000 gallons.

Such a law as the above is wholly at variance with sound reasoning in rate making. This conclusion has frequently been emphasized in court decisions. That there is a minimum charge, just and reasonable, which bears no relation whatsoever to the power consumed is realized at once when we think of the interest on meters in service, the cost of billing and a score of other costs which must be met whether any current is consumed or not.

That W. P. Geary, the chairman of the Arizona Corporation Commission, states that the law does not meet with the approval of the commission is gratifying. Indeed, the commission itself will exert a powerful influence this winter to properly amend the statutes.

The Demonstration Train

No single factor has added to the general improvement in farming methods of California more than the socalled demonstration train which was operated through the fertile valleys of that state during the past season. This train was the donation of the Southern Pacific Company and was officered throughout by experts from the agricultural department of the University of California. Thousands upon thousands of farmers throughout that great commonwealth thus enjoyed in every village and hamlet served by the railroad, a lecture and demonstration on improved farm methods. Not the least effective was the exhibit donated by the Pacific Gas & Electric Company, setting forth a modern farm irrigated by electrically operated pumps. The other improved methods dependent upon electric power proved also most helpful.

The past week has seen the inauguration at the University of California of a new and enlarged university extension policy in agriculture. Dean Hunt, the newly invested head of this state-wide effort, has every appearance and qualification necessary for the immensely important work ahead. Other commonwealths of the West will do well to emulate the splendid example set by California in thus emphasizing agricultural education, paying particular regard to the effectual work of the demonstration train and its enlightenment as to the superior advantages of up-to-date electrical applications on the farm.

Notations for Gravity of Oil

An instance of ancient fetters still binding the engineer, due to inheritance handed down from unscientific beginnings, is that of the Baume scale generally employed in the gravity notation for crude petroleum. Twaddell's, Beck's and other hydrometers present like conditions. Any notation which states—as does the Baume scale—that for liquids heavier than water one method of computation is to be used, thereby calling for 0 degrees to correspond with unity specific gravity and in the second breath employs a wholly different formula for liquids lighter than water, necessitating 10 degrees to correspond with unity specific gravity, should be tolerated no longer. It is indeed gratifying to note a general tendency in all directions to use only those scales which read in terms of the specific gravity directly.

Inconsistencies, such as this, have been met in the past and swept out of the engineer's routine.

The miner's inch of water, for instance, was a western trouble which caused endless litigation and misunderstanding. This unit has now been satisfactorily adjusted by legally defining it in terms of the more scientific unit, the second foot. While no misunderstanding exists as to an exact relationship connecting the Baume scale with the more scientific specific gravity or water comparison, still the method of juggling is awkward and unjustifiable.

On another page of this issue will be found the method in use whereby the gravity of oil is determined in the laboratory. It will be seen that in an accurate measurement gravity is actually determined according to the natural method and then transformed into the Baume scale by means of the complicated relationship existing for this awkward scale. Like the transformation of one form of energy into another, in this converting of specific gravity into the Baume scale a loss of energy is involved. Energy in the shape of brain tissue and time of the engineer is consumed. Time is money and the thousands of hours lost in yearly transformations, such as this, existing in our engineering routine, cannot but be felt in the ultimate cost of the product. This instance teaches its lesson, and may we not say with truth that the clinging to ancient and cumbersome formulae, when more scientific and accessible expressions exist, adds its quoto to the much discussed topic of the day, "high cost of living."

PERSONALS.

W. W. Hanscom, consulting electrical engineer at San Francisco, is at Los Angeles.

E. N. Fobes, manager of the Fobes Supply Company, of Seattle and Portland, is at San Francisco.

F. A. Richards, manager of the car department of Pierson, Roeding & Company, is in the northwest.

H. R. Noack, president of Pierson, Roeding & Company, has returned to San Francisco from an extended visit to the Northwest.

S. B. Anderson, district manager Pacific States Electric Company, at San Francisco, is spending the week at their Los Angeles office.

John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, has returned to San Francisco from the East.

A. H. Halloran has been appointed Statesman of the Jovian Order for San Francisco by **Frank E. Watts**, of New York City, Eleventh Jupiter.

H. B. Squires of Otis & Squires is at Los Angeles and San Diego, where he will remain until after the jobbers' convention at Catalina Island.

J. Shaufelberger, storekeeper for the Pacific States Electric Company, at San Francisco, will spend the week visiting their Seattle and Portland houses.

R. H. Marshfield, secretary of the Cutler-Hammer Company of Milwaukee, has returned home after visiting Otis & Squires, Pacific Coast agents for his company.

W. D. A. Ryan, illuminating engineer with the General Electric Company, is at San Francisco to advise on the lighting plans for the Panama-Pacific Exposition.

Alfred Still, chief electrical engineer to the mines department of the Algoma Steel Corporation of Sault Ste. Marie, Ontario, Canada, is a San Francisco visitor.

Rudolph W. Van Norden, consulting engineer, spent the past week inspecting progress on the Pacific Gas & Electric Company's great hydroelectric development at Lake Spalding.

Miles Steel, salesman with the Pacific Coast offices of the Benjamin Electric Company, has returned to San Francisco from a two months' visit to the electrical trade in the Northwest.

E. D. Marx, chairman of the California Water Commission, **J. M. Eshelman**, chairman of the California Railroad Commission, and Commissioner **Max Thelan**, have recently been in Washington, D. C., attending the three day's conference with the Department of the Interior concerning water power and water right legislation.

Glenn C. Webster, who for almost three years has been connected with the National Electric Lamp Association, Cleveland, Ohio, in the official capacity of manager of the engineering department, has recently been chosen as general manager to supervise the activities of the Tungstolier Works of General Electric Company, Conneaut, Ohio. Mr. Webster succeeds **E. J. Kulas**, who has resigned to take up other work.

A. R. Thompson has been made chairman of the recently formed Pacific Gas & Electric Company Section of the National Electric Light Association, **John D. Kuster** being vice-chairman and **H. Bostwick** secretary and treasurer. The executive committee consists of five members, each of whom is chairman of a subsidiary committee, as follows: **S. V. Walton**, papers and meetings; **F. H. Varney**, membership; **C. J. Wilson**, question box; **H. Bostwick**, editorial; **George H. Bragg** and **R. C. Powell**.

TRADE NOTES.

U. S. Electrical Manufacturing Company of Los Angeles report that they have finished the installation of 50 polyphase induction motors in the new Los Angeles Times plant, all of them being slow speed and 35 of the number are 1/3 h.p., 750 r.p.m., 3-phase geared to linotype machines.

The Pacific States Electric Company announce the purchase of the stock and good will of the Holabird Electric Company. The establishment of a store in Seattle completes a chain of houses in all the larger cities of the Pacific Coast, extending from Los Angeles, California. on the south and including San Francisco, Oakland and Portland to the Puget Sound city in the north. It is the aim of the company to carry the most complete stock of electrical goods in the Northwest.

The Union Iron Works of San Francisco have ordered from the General Electric Company a complete converting outfit and motor equipment for their new power house. This includes two 200 kw. 60 cycle rotary converters, one 18-panel switchboard, one 50 kw. motor-generator exciter set, one 165 kw. motor-generator for charging storage batteries, one 150 h.p. motor to operate pump, and 75 small motors ranging from 1 to 35 h.p. The General Electric Company is also installing three 450 h.p. synchronous motors, direct connected to Chicago Pneumatic Tool Compressors.

The Pacific States Electric Company anticipate occupying their new six-story home on Mission street, near Second, San Francisco, by December 23, 1912. The building has been specially designed for the needs of the electrical business, and when completed will be the most modern and completely equipped of any in that line. Pneumatic tube service for the rapid transmission of messages and papers between the various offices has been installed, and prominent among the other features is the provision of a roof garden, where employees may enjoy rest and sunshine during the luncheon hour.

The Pacific Gas & Electric Company has placed orders for the generating equipment of the Drum Power Plant of the Lake Spalding Development. There will be four 17,000 h.p. Pelton-Doble tangential water wheel units, operating under a head of 1375 ft., and each driving a 12,500 k.v.a. Westinghouse alternator at 360 r.p.m. The water wheels will be of the double overhung type, with 85-in. wheel runners mounted on each end of the shaft, between which the rotor will be carried, the three revolving elements being supported by but two bearings on account of the terrific strains involved. The buckets are to be of the patented Doble interlocking chain type, involving some unique principles in design. The nozzles will be of the Pelton-Doble ball joint deflecting type, with counterbalancing mechanism. The wheels will be built in the San Francisco shops of the Pelton Water Wheel Company. The generators will have several novel features of design, and will have a large overload capacity.

MEETING NOTICES.

Jovian Club of San Francisco.

At the regular meeting at Tait's Tuesday, November 26th, P. C. Butte presented a paper on "The Electrical Equipment of a Large Drawbridge."

Portland Jovian Luncheon.

The regular Jovian lunch on November 14th at the Hazelwood was addressed by Will Lipman on the subject of the "Management of a Large Department Store." Mr. Hartley presided as chairman. At the meeting on November 21 Mr. Foshay, business manager of the Portland District of the Northwest Electric Company, outlined their first development on the White Salmon River. He stated that they were installing the largest wood stave pipe in the world, it being 13½ feet in diameter. The initial installation will have

20,000 h.p. in two units, with two Francis turbine waterwheels on each unit. Generator voltage 2300 volts, stepped up to 66,000 volts. The transmission line to Portland will be 65 miles long.

Spokane Jovian Club.

At the luncheon of the Spokane Jovian Club on November 13th the speakers were Mr. Gray, chief engineer, and Mr. Hitt, assistant engineer of the Washington State Public Service Commission. Talks were also given by M. C. Osborn, general commercial agent for the Washington Water Power Company, and Mr. Tompkins of the same company. There were some thirty-two Jovians at this luncheon, a very good attendance considering that the membership is about sixty, and that about half of them are men that spend very little time in Spokane. Any and all Jovians who may at any time be in Spokane are especially welcome at the luncheons, held on the second and fourth Tuesdays in every month. C. R. Bean of John A. Roebling's Sons Company is Statesman.

Seattle Jovian Luncheon.

On November 21 an electrically cooked lunch was served to 125 Seattle Jovians through the courtesy of "The Electric Company" as planned under the direction of Burton R. Stare of the Northwestern Supply Company, chairman for the day. The menu was an elaborate one of ten courses and each separate dish had been prepared on one of the several types of electric stoves that are being shown as a part of the demonstrations of electric cookery by the Puget Sound Traction, Light & Power Company. The luncheon was held at the First avenue offices of the company. Following the luncheon short talks were made by the chairman of the day. Burton R. Stare, of the Northwestern Supply Company; P. J. Aaron, manager of the Western Electric Company; Charles M. Bliven, of the General Electric Company; H. N. Kollock, manager of the Seattle branch of the Westinghouse Company; Morton Ramsdell, sales manager of the Puget Sound Traction, Light & Power Company; James D. Ross, superintendent of the city lighting plant; G. I. Kinney, manager of the San Francisco office of the Fort Wayne Electric Company.

Los Angeles Section A. I. E. E.

The regular monthly meeting of the Los Angeles Section of the American Institute of Electrical Engineers was held in the Blanchard Building at 8 p. m., November 26. F. W. Harris presented an interesting paper on "Oil Switches and Circuit Breakers."

Engineering and Architectural Society of Portland.

The regular Tuesday Engineers' Lunch on November 19th at the Portland Hotel was well attended, the chairman of the day being E. H. West of the Portland Railway, Light & Power Company. The chairman called upon the various members for short stories, which were duly appreciated. The speaker of the day was Gus Roder, superintendent of social service department of the Portland Railway, Light & Power Company.

San Francisco Engineer's Club.

The weekly noonday meeting of the San Francisco Engineer's club was interestingly addressed by H. C. Hoover, E. M., on last Tuesday. The speaker laid special stress on the fact that San Francisco engineers should make every effort to house themselves at once in preparation for receiving the distinguished engineers from all over the world in 1915.

Club Rooms for Oregon Society of Engineers.

Some time ago a committee was appointed by the president of the society, consisting of Wm. S. Turner, P. A. Schuchart, F. A. Naramore and Gordon Kribs, with instructions to confer with other societies in Portland and investigate the advisability of co-operation in the matter of quarters. As a result of their efforts, a joint committee on co-operation was organized, composed of members from the O. S. E., A. S. C. E., A. I. E. E., A. I. A., N. E. L. A. and P. A. Club This joint committee, after much discussion of various plans, decided by unanimous vote to recommend that the proposal of the Portland Architectural Club for the joint use of its club rooms at 247½ Stark street, be made to the Oregon Society of Engineers alone, and if agreeable to it, that it be accepted, omitting for the present to include the other organizations.

As a temporary solution of the matter, in order to get the feature of co-operative club rooms in operation as soon as possible, the arrangement outlined above is satisfactory to all the interested organizations, the plan being to extend the privileges of the club, on suitable terms, to all members of other societies, individually, who desire to enter it. In the meantime, the joint committee is to make a thorough study of the situation and as soon as possible work out a permanent scheme of organization, which will provide for co-operation of all of the societies in other features as well as in the matter of club rooms and luncheons, including also joint meetings for the reading and discussion of professional papers. It is believed that the proposed agreement between the two organizations secures at once for the Oregon Society of Engineers club room facilities which many of the members have desired for a long time, and at a very reasonable cost. It is expected that funds available from present dues will be sufficient to meet the expenses of maintaining the club rooms under the proposed agreement with the P. A. Club, of which the following is a brief outline:

Article 1. Parties to unite in supporting a joint club, to be called The Oregon Technical Club.

Article 2. The government of the said club to be vested in a board of governors of five members, two appointed by each party and the fifth by the four so appointed; said Board to continue in office six months, to elect their own officers and make necessary rules for their own procedure, to be approved by executive boards of each party.

Article 3. The expense of the club to be borne by both parties as determined by board of governors, and to be approved by the executive boards of both parties.

Article 4. The club to take over P. A. Club's lease of rooms at 247½ Stark street, with furniture and fixtures, said P. A. Club retaining the use of the draughting room and its furniture, except when required for meetings of societies, not exceeding six evenings per month without consent.

Article 5. Board of governors may sublet the club rooms for meeting purposes, to other societies, but parties to this agreement shall have free use of same for meeting purposes.

Article 6.—The parties hereto to pay their shares of the expenses of the club, through their own treasurers, monthly.

Article 7. The agreement to be in force for a period of six months from its date, when it shall terminate unless continued in force by agreement, and lease and property returned to respective owners thereof.

This matter is now before the members for ballot.

I. E. S. ILLUMINATION PRIMER.

"Light: Its Use and Misuse," a primer on light and illumination which was published last month by the Illuminating Engineering Society, 29 West Thirty-ninth street, New York, has already gone into a second edition. Written in a clear and comprehensive manner for popular reading, this little pamphlet has met with immediate favor. It has occasioned considerable complimentary criticism from people who are generally supposed to have little or no interest in the subject of lighting. From the heads of engineering and physics departments of schools and colleges the society has received numerous letters of commendation together with requests for quantities of the primer for distribution to students. Architects, engineers, oculists, merchants, and others have also expressed their appreciation of the publication. Several lighting companies are planning to issue it to their customers. One large manufacturing company in London has cabled for permission to print and distribute a large edition in Europe. It is not unlikely that the primer will go into many editions.

INDUSTRIAL

A PACIFIC COAST INSULATOR FACTORY.

Electrical men throughout the country will be interested in the announcement that glass insulators are now being made at Long Beach, California, by the California Glass Insulator Company. This company has completed the installation of the latest and most up-to-date machinery, and commenced operations in October of this year under the experienced management of Robert P. Frist.

The factory is ideally situated within a short distance of Los Angeles on the lines of the Southern Pacific and Pacific Electric Railways. It consists of a large tank house, lehr shed, soda house and mixing shed, machine shop and mould room, store house and packing shed, with separate office. This plant has ten acres of ground with three and one-half acres enclosed.

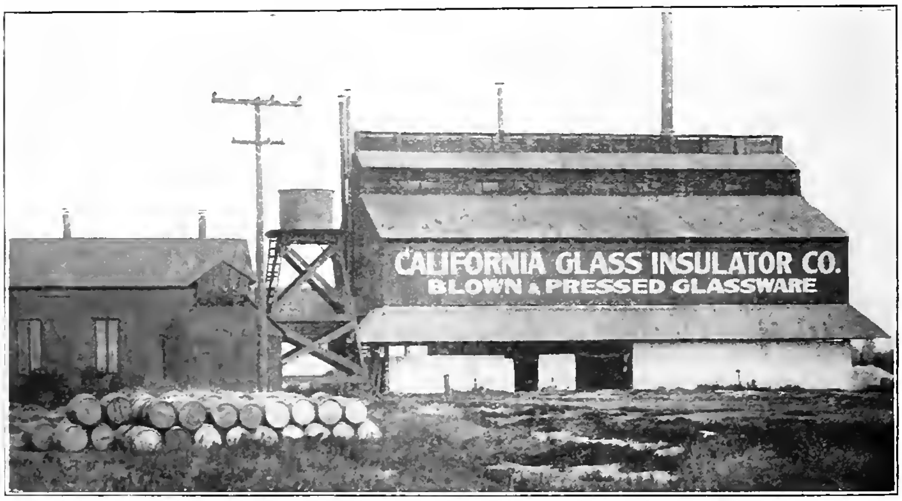
The manufacture of glass, as is generally known, consists in the fusion of a mixture of silicious sand, sodium carbonate and lime. White sand containing over ninety-five per cent of silica is found in great abundance near Riverside. California, and shipped in sacks to Long Beach, where it is stored in the mixing house. The finest grade of hydrated lime and sodium carbonate are similarly stored here. These ingredients are thoroughly mixed by hand after the proper proportions have been weighed on a most ingenious scale, which is automatically set to determine the proper proportion of each part. The material is then conveyed to the upper end of the longitudinal furnace, which is heated by sixteen especially designed oil burners. The molten mass gradually works its way down to the lower end of the melting tank, passes under a bridge wall to the working end, then is dipped with iron rods through nine apertures.

These rods are handled by men known as gatherers, who pour the molten glass into moulds. These moulds are pressed by a second man, passed on to a third who screws out the pin form, and thence to a fourth who opens the mould, takes out the finished insulators and places them on long trays.

These trays are conveyed to the annealing furnace where they are heated and slowly cooled so as to remove all internal strains from the insulator, the annealing process occupying twenty-four hours. The insulators are then stacked in piles in the open air for three months after which the perfect ones are selected and packed for shipment.

The resulting insulator is as near perfect as the most modern machinery, the greatest care, and the most rigid inspection can accomplish. Standard types are manufactured for telephone, telegraph and power use, and special designs are made in accordance with the customer's specifications.

Arrangements have been made with the Pacific States Electric Company to distribute the products of the California Glass Insulator Company, a full stock now being carried at the Los Angeles, San Francisco, Oakland, Portland and Seattle houses.



The California Glass Insulator Company's Plant at Long Beach, California.

WESTERN ELECTRIC EARNINGS.

With October the Western Electric Company completed the tenth month of its year, and shows a gain in goods billed of approximately 5 per cent over the same period in 1911. Indications are that the year as a whole will show a total of goods billed of slightly in excess of the estimate of $67,000,000 made early in the year. Last year the business done totaled $66,000,000, or within $3,000,000 of the company's largest year, so that this year will show only about $2,000,000 under the record year.

NEW CATALOGUES.

Ralph L. Phelps, Pacific Coast manager for Safety Insulated Wire and Cable Company, is using a neat postcard illustrating two cars of Safety Ruby Core for San Francisco, as an order acknowledgement.

General Electric Catalogue issue No. A4039 is devoted to Direct Current Motor-Starting and Speed-Regulating Rheostats and Panels, and supersedes previous bulletins Nos. 4600, 4559 and 4532, on this subject. No. 4974 illustrates and describes Current-Limiting Reactances designed to be placed in series with generators or transformers, and limit the flow of current in the circuit under short-circuit conditions to values which can be safely withstood by both the generator and transformer. No. 4993 is descriptive of Type RI Single-Phase Motors.

"What We Make" is the title of a compact 48-page book issued by the Green Fuel Economizer Company, of Matteawan, N. Y., describing fuel economizers, both standard and special, coverings for fuel economizers, mechanical draft outfits, heating, ventilating and drying outfits, hot blast heaters, steel plate fans, motor and engine driven fans, cast iron volume blowers, slow speed and standard speed planing mill exhausters, fan and cone wheels, wool wheels, ventilator wheels, propeller fans, vertical and horizontal engines and mechanical draft dampers.

NEWS NOTES

INCORPORATIONS.

BAKERSFIELD, CAL.—Empire Gas & Fuel Company; $100,000, by W. P. Smith of Berkeley, J. W. Reeves and H. B. Ripley of San Francisco.

CALDWELL, IDAHO.—Articles of incorporation of the Beaver River Power Company have been filed here. The principal place of business is Telluride, Colorado.

ILLUMINATION.

KELSO, WASH.—The Oregon-Washington Corporation will build an auxiliary power plant near here.

CAMAS, Wash.—The Northwestern Electric Company proposes to install a complete lighting and power system here.

QUINCY, CAL.—The Indian Valley Electric Light & Power Company has been granted a franchise to erect poles in Plumas county for the transmitting of electricity for light, heat and power purposes.

QUINCY, CAL.—Albert C. Agnew has applied for a franchise to transmit electricity for power, light and heat in the county of Plumas. Bids will be received up to January 9th, for the sale of said franchise.

PRINEVILLE, ORE.—H. V. Gates, owner of the Prineville Light & Water Company, is in the city from Portland for the purpose of turning over the property and franchise of the company to Geo. Jacobs.

SALEM, ORE.—William Hobson, representative of the Hammond Lumber Company, Astoria, has applied for permission to construct a 10,000 h.p. power plant on the north fork of Santiam and Breitenbush rivers.

REDMOND, ORE.—The Prineville Light & Water Company, Prineville, Ore., has secured a contract to furnish lights for Redmond. The company has an option on the Cliff Falls power site and propose to install a water power plant there.

SALMON ARM, B. C.—Weeden & Talbot, New Westminster, have been awarded the general contract for the construction of a municipally owned brick power plant here to cost $3510. DuCane, Dutcher & Company, Vancouver, B. C., consulting engineers.

NEW YORK.—The 11,000 shares of Pacific Gas & Electric Company stock which Samuel Insull announced was sold to a New York interest at $65, was purchased for the Electric Investment Corporation, recently organized by Harrison Williams and associates.

GRANTS PASS, ORE.—The California-Oregon Power Company has asked this city for a 40-year franchise for its power and light system, offering as an inducement 2 per cent of gross revenue in the city and certain concessions in the way of street lights for a period of ten years.

SAN DIEGO, CAL.—A special meeting of the San Diego Consolidated Gas & Electric Company, a subsidiary corporation of the Standard Gas & Electric Company, has been called for December 23d, to vote on the proposed increase of the bonded debt, not to exceed $3,000,000; the new bonds to be issued to discharge floating debt. Bonds are to be payable not later than December, 1922, and to bear interest not to exceed 6 per cent per annum.

LOS ANGELES, CAL.—The Railroad Commission has arranged for a general reduction in electric lighting rates in Southern California, beginning January 1, 1913, covering a large portion of Los Angeles county, San Bernardino county, Riverside county and Orange county. The commission made the investigation upon its own initiative and has reached an adjustment by which the Southern California Edison Company will reduce its maximum charge from 10c per kw.-hr. to 8c. The reduction will effect approximately 27,000 users of electricity and will result in an annual saving, based upon present conditions, of approximately $104,000. Los Angeles and Pasadena are not affected by the order.

TRANSMISSION.

CONCRETE, WASH.—It is reliably reported the Stone & Webster Engineering Corporation has acquired water rights of the Skagit Power Company, Cedar Bar, and will construct a large dam there to develop power.

RANDSBURG, CAL.—Arrangements are being made to equip the King Solomon mine with electric hoisting facilities as soon as the substation of the Southern Sierras Power Company is prepared to furnish power.

CLINE FALLS, ORE.—George Jacobs has petitioned the county commissioners for the privilege to install electric power, utility and private telephone lines in this vicinity. A generating plant will be built at this place.

LONG BEACH, CAL.—Immediate enlargement of the Edison power plant on inner harbor has met with approval of the city, and an order for a third unit of power has been given, making a combined capacity of 64,000 h.p. valued at $3,000,000. Edison officials recently made a trip to study the local plant, and consider how San Pedro service will be affected by the distribution of Owens River aqueduct waters.

LOS ANGELES, CAL.—Negotiations for the purchase by the city of portions of existing power systems for the distribution of aqueduct powers, are being held up until the return of W. B. Cline, head of the Los Angeles Gas & Electric Corporation, who is en route home from Europe. The Southern California Edison Company has practically agreed to sell portions of its system if the Los Angeles Gas & Electric Company will do the same, selling on the same basis.

OROVILLE, CAL.—The Oro Electric Corporation, which is seeking entry in almost every section of the Sacramento and San Joaquin Valleys, is running a power line west from Oroville to the Glenn County line at Butte Creek. This line will cross Butte Creek, which is the boundary line at that point, and will continue to the Sacramento River, a few miles farther west near Princeton, Colusa, Glenn and even some of the coast range counties are stated upon good authority as the next fields that the power is to enter. Two lines are to cross the Feather River below Oroville three miles, and will go due west across the valley floor. A corps of engineers are running a survey from Oroville to the power plant to be built at Humbug. Huge steel poles will be used, and Oroville will be the distributing point.

TRANSPORTATION.

VALE, ORE.—Ladeaux & Ladeaux, contractors, 189 Simpson street, Portland, have been awarded the contract for building a car repair shop 35x135 feet here for the Oregon Electric Railway Company.

STOCKTON, CAL.—The Stockton Electric Railroad Company has made application for a franchise to operate an electric railroad in certain streets of the city. Sealed bids will be received up to December 9.

KALISPELL, MONT.—Robert P. Austin, Walter H. Griffin and Robert J. Benn have incorporated to own and operate the Flathead Valley Interurban Railway from this city to Whitefish, Somers and Bigfork. The company is incorporated at $50,000.

EDMONTON, ALTA.—Arthur G. Harrison, member of the Board of City Commissioners, is authority for the statement that $1,500,000 will be expended by the municipality for street railway construction, rolling stock and substations during the coming year.

SAN FRANCISCO, CAL.—Mayor Rolph and William H. Abbott, chief council for the United Railroads, have signed the agreement between the city and the United Railroads concerning the use of the Market street outer tracks and the interchange of transfers between the Geary street line and the lines of the company.

SEATTLE, WASH.—E. M. Mills, representing Peabody, Houghteling & Company, bondholders of the Seattle, Renton & Southern Street Railway Company, announces that seven miles of railway will be built by the concern as soon as some slight difficulties can be overcome. The matter rests in the hands of the city council and voters.

LOS ANGELES, CAL.—Bids will be received up to December 2nd for the surrender of bonds of the Pacific Electric Railway Company, dated March 12, 1902, deed of trust given to the Union Trust Company of San Francisco. Bids should be endorsed "Bid for surrender of Pacific Electric Railway Company 5 per cent bonds, due January 1, 1942."

SALT LAKE CITY, UTAH.—The Salt Lake & Ogden Railway has been sold by Senator Simon Bamberger to M. B. Hereley of Chicago, who represents Eastern capitalists. The Electric line from Salt Lake to Ogden will be the nucleus of an electric interurban system, financed largely by Eastern capital to run throughout the State. Mr. Hereley's plans include the immediate purchase of the electric line from Ogden to Logan and the proposed electric line from Salt Lake to Payson.

MERIDIAN, CAL.—The freight and passenger trains of the Northern Electric Company are now running into Meridian again from Marysville, over the Butte Slough bridge, it having been completed. This is claimed to be the most expensive steel trestle in the country. It crosses Butte Slough and is 2600 feet long. In Meridian the company is completing its grades leading to its Sacramento River bridge. Concrete bulkheads are placed at each street crossing and the streets run under the tracks. The road will be in operation between here and Colusa next spring.

STOCKTON, CAL.—The San Joaquin Valley Railroad Company is to be merged with the Modesto & Empire Traction Company. This is the result of a recent meeting of the directors of the power company. All that remains is the formation of the new company and election of officers, subject to approval of the Railroad Commission. It is understood that the new corporation will be known as the San Joaquin Valley Company. It is the intention to capitalize for $1,500,000 and stockholders in the two old companies will be given stock in the new one in exchange for their present holdings.

VALLEJO, CAL.—The Vallejo & Northern Railroad Company has asked the Railroad Commission to investigate and determine whether the railroad, together with its branch and trunk lines from Boynton to Armijo and from a point on the main line near the town of Fairfield to Fairfield Junction, all in Solano county, yields sufficient income to defray the expense of maintenance and operation. Only a short time ago the Northern Electric Company obtained permission from the Railroad Commission to purchase the stock and holdings of the Vallejo & Northern, intending to use the line for a continuation of its own from Sacramento to tidewater and to establish connections at Vallejo for San Francisco by a new ferry service. The controlling carrier may seek to discontinue the operation of the Vallejo & Northern until its connection with Sacramento is established.

SACRAMENTO, CAL.—Construction of the Northern Electric's extension from Sacramento to Vallejo was made possible when the Railroad Commission authorized a bond issue of $10,000,000, most of which will be applied on the construction of a Sacramento-Vallejo line. Assurance is given by the company that the extension will be completed in 1913. The road will operate in connection with boats between Vallejo and San Francisco, which will make the time between Sacramento and San Francisco two hours and 45 minutes. There will also be branches to Suisun and Vacaville. The railroad company last week was given possession of the Reed orchard property in Yolo county opposite Sacramento after several years of litigation and will begin work next week grading across the property and filling the waterfront. Permission was obtained from the War Department for the construction of the first section of the wharves at that point. At Vallejo the other terminus of the new construction, the work is now within about six weeks of completion. As soon as spring arrives work will be rushed at different points along the line, so that the extension can be placed in operation at the earliest possible moment.

TELEPHONE AND TELEGRAPH.

DAYTON, ORE.—The Pati Telephone Company, recently organized, will build about 50 miles of line. Thomas Reed, president.

LAKEPORT, CAL.—A franchise to erect poles and string wires on Main street and other streets of the town, has been awarded to the Lake County Farmers' Telephone Association

CONCRETE, WASH.—A telephone line will be extended from Baker River ranger station to the government hatchery, Baker lake. Jesse M. Mann, forest ranger, will supervise the work.

DAVENPORT, WASH.—The Local and Long Distance Telephone Company's line and all its appurtenances were sold at a mortgage sale in this city, to the Washington Trust Company of Spokane.

METROPOLIS, NEV.—C. G. Winter, representing the Nevada & Idaho Telephone & Telegraph Company, has asked for a franchise which will permit them to establish a line in Elko county, through Metropolis from Wells, to Twin Falls, Idaho.

PORTLAND, ORE.—Announcement has been made that the Pacific Telephone & Telegraph Company has bought a tract of land 50 by 200 feet, upon which a new branch telephone exchange building will be erected as soon as plans and specifications can be prepared.

LANGTRY, TEX.—Geo. Coots, with a crew of men, has started work on the construction of a telephone line from Langtry to Pumpville, a distance of 12 miles. This is an extension to the Del Rio, Comstock, Langtry line, and will be pushed on to Sanderson in the near future.

LOS ANGELES, CAL.—The Title Insurance & Trust Company, J. F. Jack trust officer, desires to purchase first and refunding mortgage gold bonds of issue of Home Telephone & Telegraph Company of Los Angeles, dated July 1, to amount not exceeding $45,020. Submit offers in writing not later than December 10.

LOS ANGELES, CAL.—The franchises of a telegraph company, giving it the right to operate in the state, are assessable in California as taxable property, according to a decision rendered by the State Supreme Court. The Postal Telegraph Company brought suit in Los Angeles county to recover $625 in taxes, paid under protest. The sum was assessed upon its right to operate in Los Angeles. The company won its suit in the lower court on the grounds that it was operating a Federal franchise granted under an act of Congress and that a tax for a franchise to operate within the State was unconstitutional. The Supreme Court, however, ruled that a Federal franchise does not necessarily give unincumbered right to occupy state highways and reversed the lower court's decision with a closing sentence to the effect that the right to operate on highways within the state is assessable.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

ADDENDA OF 1911 NATIONAL ELECTRIC CODE RULES.

Underwriters' Equitable Rating Bureau, Portland, Oregon, November 1, 1912.

(Concluded.)

Rule 38. **Moving Picture Establishment Wiring.**—Special rulings published in this journal November 9 and November 16, 1912.

Moving picture machines and stereopticons installed in buildings other than theatres must be wired for a capacity of 46 amperes per arc, operated in parallel. Each machine must be controlled by a 2-pole switch and cutout, and the arc machine, if portable, must be connected up with an approved theatre plug.

Rule 45c. **Oil Transformers.**—In order to obtain the required approval of the Inspection Department, transformers must be safeguarded by resting on concrete of at least three (3) inches in depth; be placed immediately under the sidewalk in an enclosure, which must be ventilated by an opening at least six (6) inches square through the sidewalk or to a chimney or flue; the fire-resisting material used in constructing the enclosure in which the transformer is located, and by which it is effectually cut off from the remaining part of the basement, must consist of a brick or concrete wall at least eight (8) inches in thickness, access to which must be by an approved fire door. The transformer room so constructed must be supplied with sill, to prevent the flow of oil into the basement in case of explosion.

As an alternative to the above construction, the transformer may be placed in a tight steel tank, ventilated to the street and standing on concrete.

Any special transformer installations should be taken up with the Inspection Department.

Rule 50. **Rubber-Covered Wire,**
Rule 54. **Flexible Cord,**
Rule 55. **Fixture Wire,** and
Rule 57. **Armored Cable.**

In March, 1911, the specifications for rubber-covered wire were changed by the Underwriters. This necessitated the change in the color and form of the labels, which will be attached to the coils of inspected wire. (See pages 11 and 101 to 107, April, 1912, List of Electrical Fittings.)

After January 1, 1913, the use of wire made under the old specifications will not be sanctioned by this office. Consequently all contractors and supply houses who have a stock of old wire on hand for use in this territory will kindly govern themselves accordingly.

Rule 59. **Junction or Pull Boxes in Connection with Switchboards.**—The tendency of late in this territory, in a great many installations, has been to build immense junction or pull boxes at the rear of switchboards, and allow the wires to enter same from the building in conduit or knob and tube work and be distributed to their proper locations on switchboard or meterboard from the bottom or top of this junction or pull box as the conditions may demand—the wires inside the junction or pull box crossing and recrossing and lying together in a most hazardous manner.

We feel that this is not consistent with the best methods of installation, and that we are inviting trouble of a serious nature. Therefore, in the future kindly refrain from this practice, and if a junction or pull box of this character is used, we will expect all wires to be cabled and racked up in an approved method inside of same.

All installations of this character should be taken up with this bureau before work is commenced.

Rule 62e. **Cleats.**—This department will not pass a 3-wire cleat on a 3-wire system. The wires must be spaced 2½ inches apart on voltages 0 to 300, and 4 inches apart on 301 to 550.

Rule 65j to k. **Switches.**—See pages 3 to 5, April, 1912, List of Approved Electrical Fittings.

Rule 67. When cutouts are of single-pole type and not mounted in connection with switches, they are not interchangeable on any current capacity whatsoever. Consequently when it is desired to use cutouts on voltages from 251 to 600 volts A. C. or D. C., use the proper voltage rating corresponding to the system on which they are to be used.

Rule 70. **Steel or Iron Cabinets.**—After November 15, 1912, this bureau will not sanction the installation of any steel or iron cabinets except those bearing the Underwriters' Label or those approved by them. (See April, 1912, List of Approved Electrical Fittings.) This list is revised every six months, consequently it may not be complete; therefore it will be necessary to take up specific instances with the bureau direct.

We beg to call to your attention that "Steel or Iron Cabinets" are required by the National Electric Code in mixed "knob and tube" and "conduit" installations; also that "Steel or Iron Cabinets" **may be** used with "knob and tube" work.

Note that this does not apply to wooden cabinets.

Rule 83, Div. (b). **Electric Signs.**—From this date on this department will consider all wiring of Sign Structures located any place whatsoever—except on open ground—subject to mechanical injury; and same must be encased in approved rigid or flexible iron conduit.

Also, when conduit is used, Standard Cabinets must be used in accordance with Rule 70, N. E. C., instead of cabinet specified in third paragraph of Rule 83, Div. (b).

All sign circuits must be wired 2-wire.

Electrical Installations in Special Hazards.—Woodworking plants, manufacturing plants, mining plants, packing houses, warehouses, canneries, etc. Pamphlet issued on this class of installations.

Fire Alarm Systems.—Must in all cases be taken up with Inspection Department.

Electrical Fire Pumps.—Separate pamphlet issued by National Fire Protection Association. Can be obtained at the office of the Underwriters' Equitable Rating Bureau.

Service Feeders and Subfeeders for Lighting Systems and Heating Systems.—Sufficient capacity must be installed in all cases so as to furnish 3 amperes per circuit for 3-wire service and 6 amperes per circuit for a 2-wire service. Any deviations from this must be sanctioned by the Inspection Department in writing.

Service Feeders and Subfeeders for Power.—Same must be installed according to publication on D. C. and A. C. motors. When power installations are of an extensive character with a great number of motors, the "load factor" will be considered, and same should be taken up with the Inspection Department.

Paper and Cambric Insulated Lead-Sheathed Cables.—This department will not sanction in future the installation of paper or cambric insulated lead-sheathed cables in any buildings, either open, in open conduit or under the basement floor.

The paper and cambric insulated cable must end at the curb line; and rubber-insulated, braid-covered or lead-sheathed cables must be used inside all buildings.

Nothing except approved conduit must be installed inside buildings or under basement floors.

Metal Gutters.—So as to improve the workmanship and obtain safer condition when metal gutters are substituted for iron conduits, we will specify the following conditions, which must be complied with in the manufacture of these gutters. Also, we find that they have not been thoroughly satisfactory

in the past—giving considerable trouble from short circuits, etc., due to the fact that proper judgment has not been exercised in the number and size of wires installed in same:

1st. No metal gutter will be passed which is of larger cross section than fifty (50) square inches.

2nd. All metal gutters must be made with wall thicknesses and covers equivalent to iron conduit thicknesses. This thickness to be governed by the cross section of the gutter, using the corresponding pipe thickness for equivalent cross section. List of these thicknesses can be found in the Table of Conduit Sizes in the pamphlet published by this office, entitled "Wiring Data for Direct and Alternating Current Motors."

3rd. All covers must lap over the side walls of the trough and must be secured substantially in place.

4th. The number of circuits and wires must be limited to four 2-wire circuits and three 3-wire circuits in any one gutter.

5th. Partitions in gutters will not be acceptable; that is, a partition in a gutter with a common cover extending over same and fastening to the outer walls, will not be considered as two gutters. Each gutter must be built separately by itself.

6th. Gutters may be built of small size if wires in same do not exceed No. 12 B. & S. gauge; no gutter to be built of less than No. 14 U. S. gauge steel. Not more than twelve (12) wires will be allowed in any one (1) of these gutters.

THE NECESSITY FOR HAVING A UNIFORM STANDARD FOR ELECTRIC APPARATUS AND WIRING.[1]

BY N. W. REED.

Electrical contractors, when installing electric work, and supply houses, when selling appliances, would be greatly benefited if a uniform standard existed for these installations and devices. But this standard should also be satisfactory to other associations or parties, such as owners, power companies and insurance companies. With uniform requirements the work of an inspector would be very much easier, for one of his most unpleasant duties is to settle differences of opinion between an owner and some electrician, when each has a different standard. In such a case the owner and electrician are as nearly at right angles as the phases of a two-phase current, and the inspector's third standard will only change things into a three-phase, star-connected system until some one becomes the grounded neutral; and even then the work is not always satisfactory.

Property owners call upon inspectors more frequently than ever before to inspect work which has been done by contract; and not only do they wish to know if it has been properly done, but also if it is in compliance with the standards of other inspection departments. Of course, this makes it most important that there should be a uniformity of requirements among inspection departments, as varying standards will only add to the confusion. Furthermore, such uniformity will not only obtain better results from the electrical appliances and a great saving of material, but it will also reduce the possibility of fire loss.

One of the most important items to be considered by a property owner in planning a building is the danger from of fire to either building or contents. If the builder is going to consider this hazard, the manufacturers of electrical appliances and the electricians installing the devices must take into consideration the possibility of a fire being caused by electric current. Electric power has developed to such an extent that within a very few years it will be used almost entirely for lighting of buildings, driving machines in factories, heating devices of all sorts, such as irons, boilers, stoves and similar appliances. Therefore, it is becoming more important than it was a few years ago that every possible precaution be taken to decrease defects in electrical apparatus, and to have the wiring properly installed. Most electrical fires are caused by neglect, recklessness or ignorance on the part of some one making changes or additions after the first installation; and a simple method of decreasing this hazard is to encourage a sufficient number of lights, make provision for heating and other devices which may be added at a future time, and have receptacles for attachment plugs where connections can easily and safely be made.

Uniformity of standards can be attained only by the cooperation of electrical, insurance, architectural and other organizations, and should not be left to any one body. The Underwriters' Laboratories at Chicago have made tests and examinations of electrical appliances and if, in their opinion, the device is in accordance with the Code, it is labeled so it can be identified after installation, or else listed as a "Code Standard."

[1]Presented before San Francisco Jovian Club, November 19, 1912.

REQUIREMENTS FOR LOCATION OF FUSES AND SWITCHES ON SERVICE WIRES.

Section 23a, under the general heading Constant-Potential Systems, "Automatic Cut-Outs (fuses and circuit-breakers)" of the National Electrical Code for 1911, reads as follows:

(Automatic cut-outs, fuses and circuit-breakers) "must be placed on all service wires, either overhead or underground, in the nearest accessible place to the point where they enter the building and inside the walls, and arranged to cut off the entire current from the building."

Section 24a, under the same general heading, but referring to "Switches," reads as follows:

(Switches) "must be placed on all service wires, either overhead or underground, in the nearest readily accessible place to the point where the wires enter the building, and arranged to cut off the entire current."

To comply with these requirements, all electrical work must be installed in accordance with the following general understanding of these two sections, which together refer to the location and character of fuses and switches for service wires:

First: The fuses and switch for any service may be installed in separate locations, but both the fuses and switch must be within reach.

Second: When a service enters the basement of a building from underground systems, fuses must be placed where the service wires first pass through the wall of the building, or, if the space under the sidewalk is excavated, such fuses must be placed where the service wires first pass through the bulkhead under the sidewalk.

Third: Where service wires from overhead lines enter a building in conduit, the main fuses must be located just inside the wall of the building at the point where the conduit first enters the building. The main fuses must be placed in an approved iron cabinet, unless the meter cabinet is at the same location, and the fuses and switch placed inside the meter cabinet. The conduit leading from the service hood outside the buildng to the main fuses must not be concealed in the walls of buildings, but such conduit must be run exposed on the outside of the buildings to a point opposite the location of the main fuses. Under no circumstances may the length of this exposed conduit on the exterior of a building exceed thirty (30) feet. See list of electrical fittings for approved service hoods.

Fourth: All fuses protecting service wires must not exceed the allowable capacities of wires as set forth in Section 18 of the "National Electrical Code."

Fifth: When two or more wires are run in "parallel" as is sometimes done for services of large capacity, each wire must be protected by a fuse, so that the allowable carrying capacity of each wire cannot be exceeded.

BOARD OF FIRE COMMISSIONERS OF THE PACIFIC.
San Francisco, Cal., November 15, 1912.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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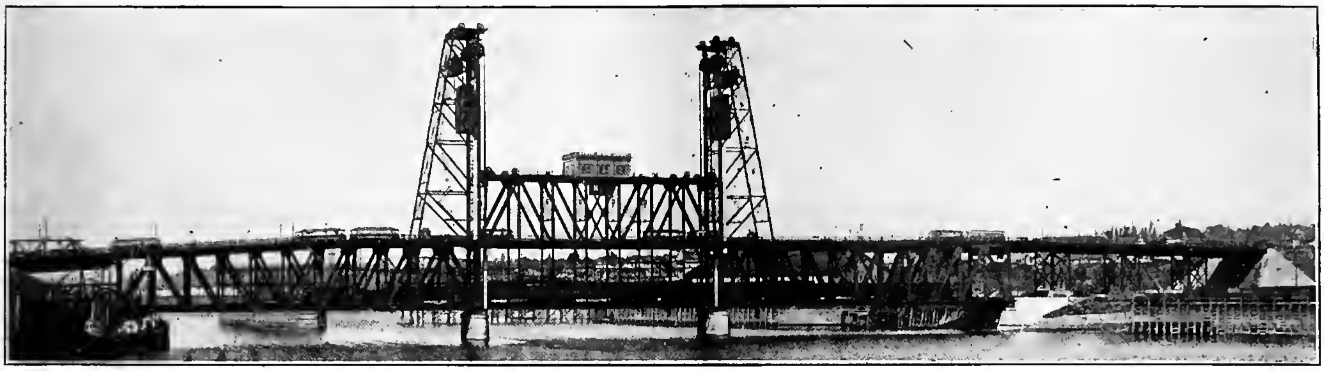


The World's Greatest Double Deck Lift Bridge Across the Willamette

THE LARGEST DOUBLE-DECK LIFT BRIDGE

BY PAUL C. BUTTE[1]

The Willamette River bridge, containing a great many novel constructive features, is the largest double-deck lift bridge in the world, and the only one having a lower movable deck. This bridge was built by the Oregon-Washington Railway & Navigation Company, a corporation controlled by the Southern Pacific Company, across the Willamette River at Portland, Oregon. The company owned a bridge about 200 feet south of the new bridge. This old bridge was built about 20 years ago. At that time they did not contemplate the rapid growth of Portland, and figured the bridge to carry a trolley car and a couple of wagons in addition to the old-style steam cars of light construction. During the past three or four years the bridge was very much overloaded on account of the jamb of trolley cars and vehicles. Portland is confronted with the same problems that prevail in San Francisco on account of the city being surrounded by hills and water. One of the factors that entered into the overloading of the bridge was the carrying of automobiles—it was possible to bring about an excessive weight on account of the smaller space taken up with the auto compared with the space of the horse and wagon. I am told that during the rush period in the evening, the bridge deflection on a span of about 250 ft. was nearly 4 in. The railroad company decided finally not to run its heavy locomotives across this bridge, and a light switching engine was coupled up on the east side when it was necessary to carry the cars across.

In the early part of 1910 the construction of a new bridge was taken up, and the firm of Waddell & Harrington, of Kansas City, was appointed to design and take charge of the work. Permits were obtained by the United States Government to erect a lift bridge (on condition that the old bridge be wrecked to clear the channel) with the east approach—beginning at the foot of Oregon street, and the west approach beginning at the foot of Third street. Another condition imposed was that at no time during the construction of the bridge was there to be any obstruction whatsoever in the channel to stop navigation. This condition caused the engineers to use their ingenuity in a very interesting way, as I shall describe later.

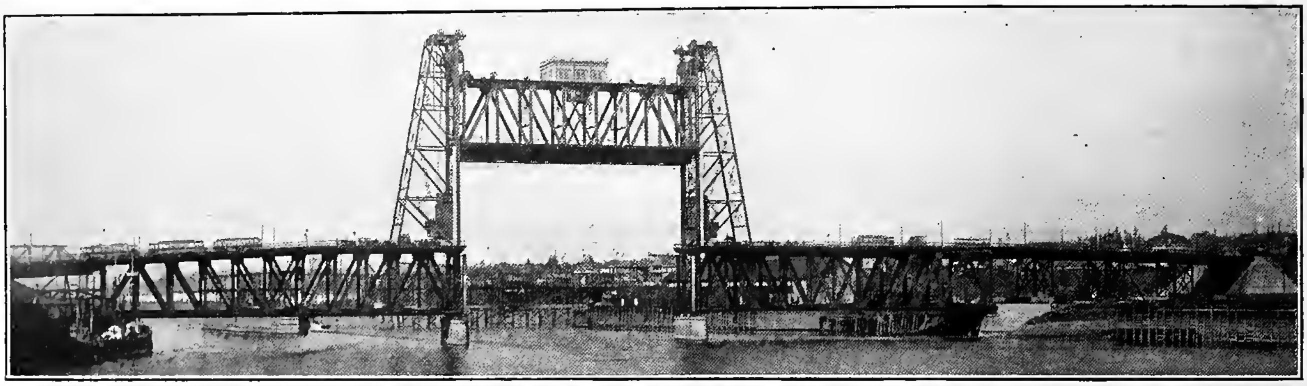
The total length of the bridge from approach to approach is 2500 ft. The concrete piers supporting the spans were sunk into bedrock, and a very formidable construction was obtained. Size of piers at towers is: Base, 50x90 ft., and height 120 ft. When the first soundings were made it was believed the bedrock could be obtained easily, but later on this proved to be only a shell of rock with clay beneath, and the real foundation was obtained by going down a depth of 60 ft. It required over a year's work to construct the piers and foundations for the approaches.

There are two decks to this bridge, the lower for a double track for train service and the upper for the two sidewalks and wagon roads and double tracks for

[1] [The foregoing paper was read by the author before the San Francisco Jovians, November 26, 1912.]

street cars. The tracks of the lower deck are laid over 6 by 8-in. wooden ties, which are placed directly on the top of steel girders. The upper deck is paved with wooden blocks laid on 4-in. planks.

The draw span is of the lift type. The Government requires a possible clearance for all vessels of 250 ft. horizontally, and 140 ft. vertically. This clearance is obtained by lifting up a 250-ft. section of the bridge to a height to give 140 ft. clearance from the high-water line. Of course, all vessels do not require this clearance, and for this reason the double-deck lift bridge with a movable lower deck is of inestimable value in preventing interference of traffic on the upper deck, for the lower deck may be raised enough to clear the top of all vessels not over 70 ft. clearance. If the vessel requires a greater clearance, the lower and upper decks are raised. It was found that only 30% of the vessels passing require over 70 ft. clearance. When the bridge was first operated many of the smaller vessels refused to pass under after the lower deck was raised, as they were used to a full open channel, and they were not able to judge the clearance. This was overcome by painting a 2-ft. strip of white along the side of the towers, as shown, with the foot markings in broad, black, horizontal stripes. Now all a captain has to do is to watch his clearance figures. The bridge operator determines the distance by means of a mechanical indicator, consisting of a hand and dial geared down and connected to the drum shaft.



Williamette River Bridge Showing Open Lift.

Steel Work.

There is over 9000 tons of steel in this bridge. The approach span weight is 6500 tons. The total weight of the lift span with its machinery is 2500 tons. The height of towers is 243 ft. to top of sheaves, and 363 ft. high from base of foundation, or about the same height as a 30-story office building. The steel work was furnished by the American Birdge Company and erected by Robert Wakefield of Portland, and there was not a single misfit in the entire structure. Besides, the erection was carried on without a mishap, and only the loss of one life, that of a painter who lost his balance on the east tower, falling 150 ft. This accident took place toward the end of construction, when most of the hazardous work was completed.

The Lift Span.

As will be seen from the pictures, the lift span is counterbalanced by immense blocks of concrete fastened to sixty-four 2¼-inch on steel cables, having a total breaking strain of 16,000 tons. These cables run over 20 ft. steel sheaves placed on the top of the towers on each side. There are similar smaller counter weights connected with each of the panel points of the lower span. These are suspended by sixty-four 1½-in. cables. It is obvious that the lower deck is suspended in hangers fastened to the lower chord of upper deck, so that the cables do not carry any weight outside of the weight of the span itself. When the lower deck is down the hangers are locked in position automatically, so that there will be no tendency for the lower deck to spring up under a moving load, such as a train of cars would be. There are also locks for holding the ends of the lower and upper decks in place. There are twelve lower deck hanger locks, four upper deck locks, and four lower deck end locks. All of these locks must work in a sequence, and to dc this the arrangement of the electrical details forms a very important part.

The motors, controllers and electrical equipment was installed by the Butte Engineering & Electric Company, and a great deal of the apparatus was built in its local shop.

The electrical equipment consists of a 15 h.p. motor for operating the hanger locks, two 200 h.p. motors for the upper deck, two 200 h.p. for the lower deck, and two 15 h.p. for operating the lower deck end locks. All of these motors are provided with magnetic brakes, the larger brakes being fastened directly to the steel work. The voltage is close to 600 d.c., and all motors are of the series type, entirely enclosed. The 200 h.p. motors have a normal starting torque of 4500 pounds.

Considerable thought was given toward providing means in case of breakdown of electric service or of parts of the machinery.

First—In case of breakdown of motors, an interconnecting switchboard is provided, consisting of eight 4-pole double throw switches and four 2-pole double-throw switches for solenoid brakes. The control is arranged so that any one, any two, or all four motors may be connected in series parallel, or so that any one, or any two motors may be cut out of service at will. Suitable clutches are provided to connect the motors mechanically to either the lower or upper decks.

Second — In case of breakdown of service, a double-throw switch is provided in the operator's

house, connecting with either of the two services on the east and west sides of the bridge.

Third—In case of total breakdown to both services, a winch is provided with suitable levers to operate the bridge by man power. Of course, this would be a very slow process, and would require considerable time to perform a complete opening.

The motors are controlled by a unit switch system of multiple control, so arranged and interlocked that—First, the current cannot be turned on to the motors which operate the upper deck until the locks have been opened and the deck is free to rise. Second, the current cannot be turned on to the same span until the lower span is raised to its highest point, properly locked there by the solenoid brakes on its motors.

Limit Switches.

The limit switches are arranged to cut off the current when the upper deck and lower deck have reached the limit of travel. These switches operate on the screw principle, geared to the drum shaft. In case the operator allows the bridge to go beyond the limit, he cannot operate the bridge without pressing a special short-circuiting button placed near the controller handle. There are also limit switches on the lower and upper deck lock motors, but after these were placed in operation it was found that a signal system, indicating when the limit was approached, was preferable.

The Operating Room of the Great Bridge

Signal Lights.

There is a complete signal system on the bridge, enabling the operator to find out exactly where he stands, and is a precaution against accident. There are signal lamps for indicating the extreme positions of the hanger locks and the end locks of the lift or upper deck. These are located in the operator's house, and connected with the power circuit—two lights for each lock—arranged so that red light will glow when the lock is fully driven, green light when fully opened.

As this bridge is the first of its type, special instructions were required for semaphore signals from the government. At the center of the lower deck on both up and down stream sides there are four cast-iron semaphores, each having four 8-in. Fresnel lenses—colored green and red. Each semaphore has a separate switch, and a master lamp of corresponding color in series with it in the operator's house. The following combination is worked:

Two red semaphore lights indicates both decks down.

One red upper, 1 green lower light , upper deck down and lower deck up, respectively.

Two green upper lights indicate both decks up.

A special trolley construction was used to make connection to the lower deck.

There are also four pier semaphores of standard type.

There is a complete system of electrolier lighting on the bridge, as well as bells and telephones to signal between the operator's house and the upper and lower decks. A five-ton traveling crane is installed in the machinery house.

The bridge engineers are deserving of a great deal of praise for clever designing. Before the structure was accepted by the owner, it made over a thousand successful trips without requiring any adjustments.

AN INVESTIGATION OF EXPLOSION-PROOF MOTORS.

The results of a series of investigations of explosion-proof electric motors for mines is published in Bureau of Mines Bulletin 46 by H. H. Clark. The general conclusion is that a thoroughly satisfactory motor has not yet been submitted.

The term "explosion-proof" refers to a motor inclosed by a casing so constructed that an explosion of a mixture of mine gas (methane) and air within the casing will not ignite a mixture of the same gas surrounding the motor. There are two classes of motors so constructed: First, a totally inclosed class built strong enough to withstand high internal pressures and so designed that the efficiency of all inclosing covers can be satisfactorily maintained; second, a class provided with relief openings or valves designed to relieve the pressure of an explosion within the motor casing and to cool any products of combustion discharged through the valves.

A satisfactory motor of the first class is much more expensive to build than an equally safe motor of the second class. For this reason, attempts to make motors explosion-proof have been confined chiefly to motors of the second class.

The function of explosion-proof devices for electric motors is to reduce below the ignition point of gas (methane) the temperature of any flames that may be discharged from the motor casing.

Of five protective devices submitted, one was rejected without test, one failed completely in test, and each of the others failed under one or more conditions of test. One of the three devices last mentioned dis-

The Bureau of Mines is prepared to make tests of explosion-proof motors for the purpose of establishing a "permissible list" of such machines. Schedule 2 of the bureau described the conditions under which such tests will be undertaken and states the fees charged for the work. This schedule may be obtained by applying to the Director of the Bureau of Mines, Washington, D. C.

RATE FIXING AND APPRAISAL

AUTOMATICALLY DIRECTED METHOD OF RATE FIXING AND PRICE CONTROL.

BY F. K. BLUE.

The automatically directed method of rate fixing which was suggested in last week's issue is here presented in greater detail. The principles involved in this method would be practically carried out in the following manner:

The physical valuation of the properties of the given corporation would be established to correspond to the actual legitimate investment upon which the stockholders were entitled to receive dividends.

To establish service rates or prices for say next year, the previously estimated operating expenses for next year would be estimated from actual expenses of this and previous years, according to definite methods stated in the franchise and conforming to the nature of the utility.

The previously estimated sales for next year would be estimated from this and previous years according to similar principles.

The estimated sales for this year would be computed by averaging the actual sales for this and previous years according to methods defined in the franchise.

The estimated gross earnings for this year would be computed by applying this year's previously estimated rate of profit to this year's estimated sales.

The estimated operating expenses for this year would be computed by applying the properly adjusted actual unit cost of production for this and previous years to the estimated sales for this year.

The difference between the estimated gross earnings and the estimated operating expenses would be the estimated net earnings for this year.

The ratio of these estimated net earnings for this year to the average market valuation of all outstanding stock based on prices asked during the year would form the rate of profit to be used in fixing the service rates and prices for the next year.

This rate of profit applied to the physical valuation of the properties would give the previously estimated net earnings for next year.

These previously estimated net earnings for next year added to the previously estimated operating expenses for next year would give the previously estimated gross earnings for next year.

Then the previously estimated gross earnings for next year divided by the previously estimated sales for next year would establish the service rates and prices for next year.

To illustrate the working of this method, suppose that the rate fixed for service be such that the rate of profit for this year is 10 per cent on physical valuation. Suppose further that the conditions with regard to probable future income from the property is such that the average investor feels that he can just afford to invest his money in the enterprise for an expected return of 7 per cent on his investment. The conditions resulting from the methods of rate fixing to be followed are such that, although the return on investment during this year is known to amount to 10 per cent on physical valuation, yet it is also known that the return in the future will be gradually reduced to about 7 per cent on physical valuation. Therefore the stock valuation for this year will not be about 120 on a par value of 100, corresponding to a perpetual annuity of 10 per cent on the physical valuation, but it will be at some figure considerably less, probably at a value of about 110. This average stock valuation during the year, then, will represent the price which the average investor could just afford to give or take for the stock. The present year's profit of 10 per cent, divided by the present year's average valuation of 110, gives a rate of profit for next year of about 9 per cent. At this rate of return on physical valuation, the stock valuation at 7 per cent for next year would be about 107. The 9 per cent profit for next year, divided by the average stock valuation of 107 for next year, gives in turn a rate of profit to be applied to physical valuation of about 8½ per cent for the year following. It is evident that by continuing this process, the rate of profit will finally approach 7 per cent, which is the investor's estimate of the value of the risk involved in the enterprise, and the average valuation of the stock will finally approach the physical valuation of the properties.

In the same manner, if the rate of profit were at any time below the rate required by the investors' valuation of the risk involved in the undertaking, this rate of profit and the stock valuation would be gradually increased until it approached the investors' estimate and the physical valuation.

From this it appears that if the owners of the stock tried to increase its valuation beyond that which an average investor would be willing to pay for it, they would soon suffer loss of income on account of the decrease in the rate of profit determined by this year's valuation, which would result in a smaller rate of service to be fixed in the next year. On the other hand, if the stock owners should reduce its valuation this year, thinking thereby to be able to establish a higher rate of profit and thereby enjoy a greater income from the higher service rate that would follow in the next year, they would risk the loss of their expectedly greater return through the purchase of their stock in the market by investors who might be willing to accept a smaller rate of profit on their investment.

Fraudulent price fixing would be at once indicated by an abnormal fluctuation in the value of the stock as soon as discovered by an investor not in the conspiracy.

To provide for deferred dividends, the rate of profit at which they are to be amortized should be fixed by competitive bidding for the original fran-

chise, the service rate during the period of amortization being estimated by adding a return based on the rate of profit bid to a reasonable future cost of production at normal plant capacity.

To conform to the principle that the immediate relation of profit to cost of production should not be destroyed, the original physical valuation should be based on an estimate of cost made previous to construction of the plant and adjusted by unforseen expenses and savings occurring during construction but for which the management was not responsible.

Many minor adjustments would be necessary, and it would undoubtedly take much thought and attention to detail to put such a method in practice in a perfected form, but it is fortunate that the elements of difficulty involve points of relatively minor importance. There could be considerable discrepancy and rough approximation in regard to these points without detracting seriously from the value of the method as a whole in substantially accomplishing the valuable and important results intended in an eminently satisfactory manner.

Practical Advantages of This Method of Control.

By this method the advantages of competition would be secured more exactly than is possible under existing normal competitive conditions. Under true competitive conditions the supply of capital is determined by the relative utility of present goods and future goods to the investor who furnishes such capital. This condition is exemplified in the market control of the price of bonds, where the economic forces tend to produce a stable equilibrium. But in the case of stocks, even under conditions of normal free competition, no such tendency toward equilibrium prevails, because the expected return on investment, instead of being known and definitely fixed, depends primarily on the price of the product. Now if this price depended exactly on what any investor in the market was willing to risk his money in the enterprise for, then a true equilibrium would be approached. But this is not the case. Price even under the most normal competitive conditions is regulated by competition within much narrower limits. At best it depends on what those in the same business only are willing to risk their money for, and the slightest tendency towards community of agreement, even if unconscious, may raise the price to just below the point which those in business estimate would be too attractive for a would-be competitor, while a disagreement may unduly lower the price temporarily during "destructive competition" and lead to business failure and finally a literal combination of interests which may raise the competitive price higher than that established by agreement. There are many degrees of monopoly, which after all is only relative, but in all cases price, if lower than what will secure maximum profit on investment, depends upon the shareholder's estimate of possible competition, not on his willingness to risk his money in comparison with the willingness of any other investor in the market as in the case of bonds.

Therefore, if this method be applied to price control it will provide a truer competitive condition than that prevailing under the most favorably existing conditions of normal competition, without sacrificing any of the conditions which encourage business enterprise, and without the danger of "destructive competition." Practically it would place such stocks on the market on a basis similar to that of bonds, and in two ways on a better basis. In the case of bonds, the future return is invariably fixed in number but not in value at the investor's estimate at the time of purchase, so that changes in the rate of interest and in the value of gold—the unit measure of price—affect either the creditor or the debtor adversely in a manner that cannot be avoided unless all investors become prophets. In the other case, however, the future return on stocks would depend not only on the investor's estimate at the time of purchase, which would determine next year's income, but also on his next year's estimate which would determine the income of the succeeding year, and so on. And further, if the physical valuation were adjusted each year to correspond with changes in the value of gold as indicated by proper index numbers (until a method of adjusting the numerical value of money to the relative value of gold is adopted), then the value of future income from stock would have a further element of economic stability not possessed by bonds.

By the adoption of this method of price control, therefore, stocks would have two advantages in economic stability over bonds, since the value of returns would follow gradual changes in both the rate of interest and the value of gold. Monopoly would be a desirable institution to all parties concerned, and therefore a condition to be encouraged, while all the economic advantages of competition would be realized at the same time in a more perfect manner than has ever been possible in the past. The advantages of both monopoly and competition would benefit both the producer and the consumer, while the investor would have more assurance of getting all that he thought his risk was worth (just as if he bought a well secured bond), since gambling in and manipulation of such stock would be confined to very narrow limits, and the returns resulting from unusual business enterprise would be enjoyed more nearly by those who created them. Since all fictitious stock valuation would be eliminated, it would be much safer for banks to lend money to such enterprises, and likewise it would inspire the confidence of the depositors in such banks. Serious business crises would then be averted, since it would be publicly known what was represented by the securities on which such loans were based.

OREGON DITCHES RUINED BY BEAVERS.

Beavers, which are protected by law in Oregon, are becoming such an unbearable pest in destroying some of the irrigation ditches in the state that a law will be introduced at the next session of the legislature to allow them to be killed. Tygh Valley, one of the first districts in Oregon to be put under the charm of modern irrigation, is so infested with the animals, that irrigation ditches have been diverted from their course in a night, others made absolutely useless, young and tender trees sawed off or peeled and eventually killed and other crops ruthlessly ravaged.

RATE FIXING AND APPRAISAL

STATE CONTROL VERSUS MUNICIPAL.

BY WILLIAM J. HAGENAH.

Much discussion is still the order of the day relative to the effectiveness of state control as opposed to each municipality directing its own utility undertakings. The subject came up for discussion at the recent conference of northwest municipalities at Walla Walla, Wash. William J. Hagenah, former chief statistician of Wisconsin, contributed some notable remarks apropo to the subject from which the following abstract is taken:

The necessity for state control is emphasized by the relationship between the making of rates and taxation. For either purpose the property of a corporation must be valued. In those states which have followed a progressive policy with respect to these problems we see state tax commissions or boards of assessment working side by side with the public service commissions, each profiting by the data collected and the expert assistants of the other. This condition is destined to remove the tendency of the cities to claim a high value for purposes of taxation but a low value when the making of rates is in issue. The co-operation of public departments cannot be realized for any great length of time where the taxing and rate-making powers are exercised by two distinct and widely separated political units, each responsible to a different authority. State commissions are continuing bodies with a line of precedents to consider, not unlike those of a court, while the policy determining branch of our city governments generally changes every two or four years.

The physical conditions of our public utilities make local regulation impractical. Many utilities, especially electric companies, have been wisely brought under one management in the interest of economy. Especially is this true in the western states where power is transmitted over long distances from a central hydraulic generating station. It is not difficult to find instances of as many as thirty or even fifty communities being served by a single company from one transmission system, which often extends into two or more states and through a large number of cities and villages. Obviously, every city receiving service from such a system must be charged with its proper proportion of the value of the system, but it is difficult to understand how a score or more cities, acting independently as they must, could properly assign these values to the satisfaction of each. One can imagine conditions of municipal regulation of such a corporation where in time cities might claim a large interest in the transmission system for purposes of taxation, but deny such interest when the question of rates was in issue. The same condition could arise with respect to water companies which are frequently compelled to go long distances to mountain streams or lakes for an adequate supply of wholesome water, or could disturb the street railway system of any large city which is nearly always interurban in character. Not many years ago cities sought to regulate railroad terminals. Today the error of such a course is generally understood and the facts which brought about state regulation of interstate carriers apply with equal force to state regulation of all public service corporations.

It would be impossible for municipalities to maintain an organization skilled in public utility matters. Aside from a very few large cities, there are none which possess conditions requiring a permanent organization. While a particular service might require an extended investigation at any time, for which purpose a large and expensive staff would be required, this organization would not be necessary after the disposition of the case. It would be extremely difficult to build up such a staff in a short time and unless constantly employed it could not be maintained. Unless regulation is predicated upon thorough investigation, there is grave danger of the issues in the case becoming more or less involved with considerations other than those warranted solely by the facts. A city commission could not obtain comparative information from other companies and compel the opening of their books and records, nor could it prescribe a proper uniform system of accounts and cost analysis. Under such a method not only would the utilities of every city be compelled to deal with a separate regulating authority following different lines of thought and precedent which would destroy uniformity of methods for regulating properties, but the requirements of different cities would prevent the comparison of operating repairs among the companies themselves. Rates schedules would be computed by different methods and with chief regard to different basic conditions and standards of service such as gas pressure, candle power and heating qualities, electric voltage, water pressure, etc., would undoubtedly vary in different cities of the same state. In one instance we might find depreciation charged in operating expenses while in another city no provision for depreciation would be required. Political expediency or popular demand could frequently obtain, even above the wishes of city officials, a change in the rates exacted, or might require a standard of service which the use of the property and the revenue collected would make impossible without serious loss to the company.

The question of maintaining a commission of the character which the large utility investment in any state requires would be prohibitive for a single city. Our municipalities are today facing problems arising out of city growth and government, such as education, police and fire protection, sanitation, street improvements, etc., which are a severe burden on the public. In fact, city tax budgets are growing at such a rapid rate that conservative financiers have advised caution. For these reasons cities should look with pleasure upon the release from a function of government which is not local in character. It is not unusual to observe a city expending out of the public treasury in prosecuting a utility investigation a sum as large as that

expended by some states for maintaining a fully equipped public service commission in the discharge of the regulative duties for all the cities of the state.

Utility history further shows that companies operating under short-term franchises find great difficulty in securing extensions except through granting reductions in rates or other concessions which greatly hamper the sale of securities for needed improvements. Frequently to avoid being the object of political attack, being forced into expensive litigation or threatened with wasteful competition, corporations accept such reductions, or assume duties which increase their operating expenses, as a means of escaping from an unpleasant immediate situation, hoping to secure amends through some fortunate circumstances in the future. Any course which compels a public utility to curtail expenditures of operation, to neglect proper maintenance and improvements and to postpone provision for depreciation, will eventually be reflected through inferior service to the public. Most of these burdensome conditions are forced on the companies because of the belief that their securities are "watered." Just how this phrase originated is not known, but it has served to create a popular impression which has been a powerful force against the development of public service corporations. Many arguments concerning such corporations are met with the ever ready answer, "watered stock," although analyses of facts show that the question of capital issues is not in the least involved. This same unreasoning attitude of the public has been a barrier to the proper consideration of many utility problems between city and utility officials and has prevented much needed betterment of service.

Another of the misunderstandings of the public which has done much to bring about state regulation has been the abuse of the power of municipalities to grant franchises to competing utilities. In every state where public service commissions have taken up in earnest the great work of corporation control there has been announced the doctrine that a public utility is a natural monopoly and that the interests of the people are best served by regulating and protecting such monopoly in the discharge of its duties as long as it conforms to the obligations of the law. Opposed to this, the policy of our cities has been to encourage competition and in this manner they have helped to create the very conditions which are now criticised and from which they seek to escape. It is difficult to comprehend what a city expects to accomplish by permitting another utility to enter its boundaries when there is already one which serves the public adequately at reasonable rates. If the existing utility is giving inadequate service or is charging excessive rates the remedy lies in the power to compel that company to improve its service or to reduce its rates instead of inviting another similar corporation to tear up the city pavements for its pipe lines or rails, or to deface the streets with additional lines of poles. If an existing company is rendering adequate service at reasonable rates there is nothing to be gained by duplicating the plant and expecting two utilities, each completely equipped, to exist on the traffic and service which heretofore has supported but one company.

State regulation is further desirable because through it is possible the regulation of municipally owned utilities as well as those privately owned. There is no reason why a distinction should be drawn in the regulation of utilties because of the character of the ownership. It is immaterial to the consuming public as to who furnishes the service or who owns the plant so long as the service is adequate and efficient and the rates charged are reasonable. There should not be included in the cost of service any item incurred through a matter of sentiment concerning either the corporate or municipal form of ownership. The paramount consideration is as to which can render the best service at the most reasonable rates. The taxpayer and subscriber to utility service is entitled to receive from the municipal plant the same publicity of accounts and operating conditions, the same regard for actual costs, and the same compliance with the service requirements which are exacted of privately owned utilities. A municipally owned utility should not be operated as a source of revenue for the general fund of the city, nor should the city or any class of customers receive service at a rate which is discriminatory with respect to other classes. State regulation of municipally owned utilties is not an infringement on municipal rights; it merely provides that when a city chooses to engage in a quasi-public undertaking it shall discharge that duty with the same degree of efficiency and for as reasonable rates as would be required if the obligation were discharged by individuals or corporations.

That municipal regulation has not been attended with success is due to the fact that the regulation of the modern utility company is not a municipal function. In our theory of government there are certain functions which are distinctly local in nature. Some are state functions, while others are national in scope. Whatever character the utility may have assumed in past decades it has lost through the growth of modern conditions in which it has taken a prominent part. The regulation of such corporations in their present state-wide operations, and even interstate relation, is no more a municipal function than is the question of public education, the administration of justice, regulation of banks, or the care of the criminal and unfortunate classes. As industry and governments grow, new functions for the body politic constantly arise, while the older functions assume new aspects and those once local in character become functions of the state, just as many former functions of the several states are now being exercised by the Federal government.

Prominent among such changes has been the growing demand for state-wide regulation of all public service corporations. The conditions which affect one form of service also affect the other, and so closely inter-related are those forms of business that they cannot be successfully regulated by a score or more municipalities each operating independently. The arguments for regulation today are founded on broad principles of public policy. Modern economic thought and legislation seek to give stability to invested capital in legitimate enterprises, the substitution of a perpetual franchise or indeterminate permit for the short-term franchise, with the evils attendant upon it, the

publicity of accounts of monopolies, definite standards of service, and the physical valuation of properties charged with a public duty. It is opposed to political interference with the public service, is opposed to the waste of resources, and aims to accomplish these desirable ends through a permanent state administrative agency. Such regulation of all public service corporations through a single commission properly authorized by law and provided with facilities for the investigation and determination of all questions affecting such corporations has proved to be a success in Massachusetts, New York and Wisconsin and in a large number of states which have recently adopted this policy and modeled their legislation on that of the last two states.

SCIENTIFIC PLANT MANAGEMENT

FUNDAMENTALS OF FUEL-TESTING—WATER DETERMINATION.

BY J. P. ZIPF.

The amount of water in the oil is determined by distillation. The still is a copper vessel about 4 in. in diameter, and 6 in. high (Fig. 2), placed in an asbestos hood, the stem projecting to the condenser (upper left hand corner, Fig. 1). The condensate is discharged into a graduated tube.

The sample can is immersed in a water bath, and the cover having been released, is raised to a temperature of 150° to 170° F. The cover is fastened tightly and the can agitated for several minutes, in order that the water, which may have settled to the bottom, may be thoroughly mixed with the oil. For thorough agitation the sample can should not have been filled more than two-thirds with oil. One hundred c.c. of oil, measured in a graduated jar, is poured into the still. The exact measurement of the oil is difficult without experience, as a froth collects on the surface of the oil, obscuring any definite meniscus. The jar is washed with 50 c.c. benzol and 50 c.c. toluene, the washings being poured into the still. It should be mentioned that toluene absorbs a little water, and results might be interfered with if the toluene is not previously saturated, hence on opening a fresh bottle 5 or 10 c.c. of water should be added. The presence of water at the bottom of the bottle shows that the toluene is saturated, but care must be taken not to pour this water into the still with the toluene.

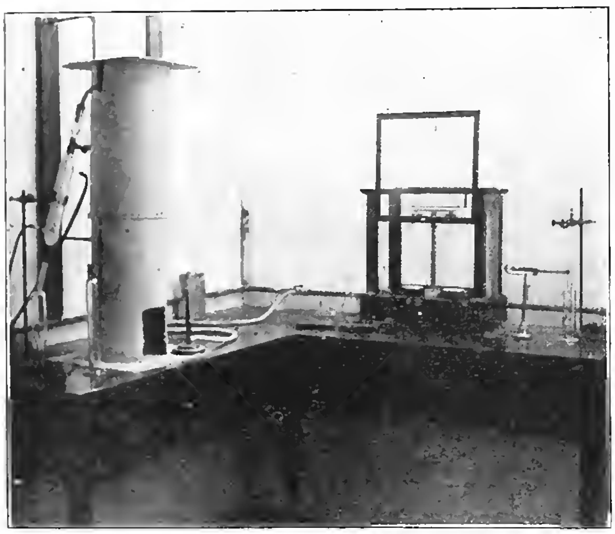


Fig. 1. General Layout for Fuel Testing Laboratory.

The still, after being shaken gently in order that the contents may be mixed without splashing into the stem, is placed in the asbestos hood and connected with the condenser. The hood and cover is provided to surround the still with a blanket of hot air at a uniform temperature. The still is heated gradually to a temperature of about 300° F., this temperature being reached after heating about fifteen minutes, and maintained for another fifteen-minute period. A thermometer for temperature control can be seen at the right side of the asbestos hood (Fig. 2).

The benzol passes over at a temperature of about 176.7° F., thereby wetting the condenser tube so that the water which follows will not cling readily to the latter. The toluene passes over at about 230.5° F., carrying down any water which does not happen to remain in the condenser tube. All of the toluene does not pass over, usually 15 c.c. to 20 c.c. remaining in the still with the oil. In order to make up the deficiency in toluene in the graduated collecting tube, about 15 c.c. are poured down the condenser tube to free any small drops of water which may persist in remaining.

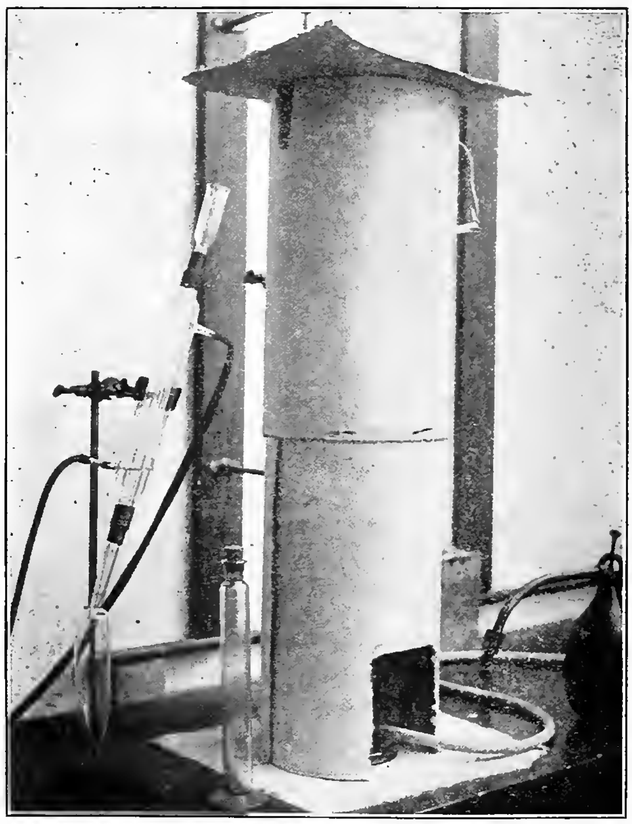


Fig. 2. Copper Still Used for Water Determination.

The still, while at a high temperature, is drained. As its contents were entirely free from water, it may be used without additional cleaning.

The distillate is at first cloudy, but later becomes clear, a sediment settling on the surface of the water which collects at the bottom. Numerous small drops of water cling to the side of the graduated tube, and must be released by knocking them off with a short wire. If the resultant water is read as cubic centimeters, the percentage of water (by volume) in the oil is easily obtained.

The water is separated from the mixture of benzol and toluol in a filter bottle, and the latter mixture can be used repeatedly.

The percentage of water by volume is, for all practical purposes, equal to the percentage by weight, the error being negligible except with a "light" oil or with considerable water present.

Distillation data on the oil we are considering is as follows:

Oil (poured from top of can)	100 c.c.
Benzol and toluene	100 c.c.
Resultant distillate:	
Water	4.7 c.c.
Benzol and toluene	82 c.c.
Condenser tube washed with toluene	16 c.c.

Thus the percentage of water by volume is 4.7%.

It may be said that this oil had been standing for six months; an earlier determination gave 7.8% water. The difference in these two values is due to the water settling. Had a sample been taken from the bottom of the can, it would have shown more than 7.8% water.

The specific gravity of the dry oil is found from the simple relation between weight, volume and specific gravity, as follows:

Let W be the per cent of water by volume,
S the specific gravity, subscripts w, o and m, referring to water, dry oil and mixture respectively.

S_w at 60° F. = .9990.

The per cent of oil by volume is 100 — W

$$S_m = S_o\left(\frac{100 - W}{100}\right) + S_w\left(\frac{W}{100}\right)$$

The only unknown is S_o, and by transposing

$$S_o = \frac{S_m - S_w\left(\frac{W}{100}\right)100}{100 - W}$$

$$\text{Thus } S_o = \frac{.9610 - .047 \times .9990}{.953} = \frac{.9141}{.9530} = .9591$$

S_o at 60° = .9591.

The per cent of water by weight is not equal to the per cent of water by volume, but for all practical purposes may be taken equal to it. Error is nominal except with very light oils or any oil with considerable moisture present.

.047 c.c. of water @ 60° F. weighs	.0469 gms.
0.953 c.c. of dry oil @ 60° F. weighs (.9591 × .953)	.9141 gms.
1.000 c.c. of mixture weighs as before.............	.9610 gms.

The per cent of water by weight is therefor

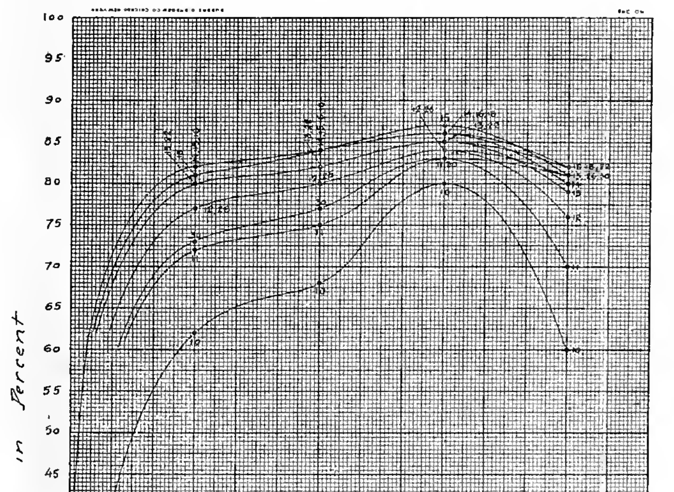
$$\frac{.0469}{.0910} = 4.89\% \text{ water, and the oil } \frac{.9141}{.9610} = 95.11\%$$

Thus by volume there is 95.3% oil, and by weight 95.11%

COMMUNICATION ON "ELEMENTS OF HYDRAULIC ENGINEERING."

To the Editor: In some of your recent issues Geo. J. Henry Jr. has published a series of papers, entitled "Elements of Hydraulic Engineering." The engineering profession is indebted to Mr. Henry for having opened his treasure chest of many years' experience and for having brought out information which heretofore had been carefully guarded by manufacturers of hydraulic power machinery as a deep secret; possibly under the assumption that it might become detrimental to their interests if the knowledge of such data was spread at large.

Having had some experience in similar lines I have read Mr. Henry's paper with a great deal of interest and found that in some details my records of facts do not seem to quite tally with his; fearing that



I might have misunderstood or misinterpreted some of the subject matter, I should like to be corrected by Mr. Henry, if wrong in my interpretation of his remarks.

On page 1 Mr. Henry gives two tables, IV and V, referring to the efficiencies of waterwheels of the tangential type, and states:

A careful review of all reliable data I have been able to collect indicates that the best efficiencies for tangential wheels are

obtained with pitch diameter from ten to thirty times the jet diameter. Efficiencies that should be obtained and the corresponding specific speeds are given in the accompanying table V and the efficiencies are further plotted in Fig. 25.

Enclosed herewith please find a diagram on which I have plotted a series of efficiency curves for wheels of different specific speeds, taking the efficiencies given on table V as points for each curve. Characteristic in all these curves is a depression between quarter load and three-quarter load, which becomes more pronounced with increasing specific speed. I am unable to account for this theoretically, and of all the test data of tangential wheels I have on hand none shows this peculiarity. An explanation of this phenomenon would doubtlessly be appreciated by everybody interested in this branch of engineering.

HEINRICH HOMBERGER,
San Francisco, Nov. 27. Consulting Engineer.

READINESS TO SERVE METHODS

CARD SYSTEM FOR RECORDS.

BY ROSS B. MATEER.

Card records of the consumer, his address, type and number of lamps used, motor and horsepower installed, are now a part of every central stations commercial organization. Data as to diversity factor, average revenue per consumer connected may be obtained only when such information is desired by any association promoting the welfare of the central station, or when the executive officers are actuated by a spirited demand on the part of the directors for information that conveys a comprehensive idea of the present condition of the property and its possibilities. That such information, available only on demand, is generally lacking is to be regretted, but that the quasi-public utility usually values its business from its own point of view without reference to the consumer is deplorable and an evidence of the lack of co-operation that should characterize the relations existing between consumer and utility. Perhaps the central station is imbued with the principle that the object of all business is revenue and seeks to maintain only such records as tend to show a maximum of revenue at a minimum of expense, and, in developing business prefers to handle existing customers with the sole object of increasing their bill and yet have such increase satisfactory to the patron served, at least to such an extent that no complaint is registered. Such a policy may work out when urban business of a commercial and residential character is considered but cannot be applied to the securing of agricultural business and to the maintaining of records which will prove of value to the utility and those served with its product.

The card records now existing in some central stations are no more complete than the one reproduced and which has served its purpose for all classes of revenue producing business perhaps through a desire to avoid the extra expense of printers' ink and the salary occasioned by solicitors whose duty it was to secure data necessary for accurate reports. Some companies have by the segregation of records into various classes procured available data for their own use, but generally have avoided any reference to the patron served and his returns from the investment in juice and its use.

Form 188 S. F. 5438

Contract No. .... *Exp. Date* ....
Solicitor ....
Name ....
Address ....

"A"

LOAD
Occupied as ....
Incandescent ....
Arcs ....
H. P. ....
Miscellaneous ....

Rate ....
Collection Address ....

With a view of encouraging a desire on the part of the central station to determine the value of "juice" to the agriculturalist when used to supply the necessary water for irrigation purposes or to remove the excess seepage which in rainy seasons is detrimental to the land and the crops, a card of such size as to be readily filed in a cabinet is desirable. This card should contain all the information needed to arrive at the cost per ton of output in fruit crops or vegetables and so on. It should also indicate the type and character of the motor and pumps recorded, with the requisite data on suction and discharge head. The card now in use by one of the large central stations is presented herewith. A careful inspection of the card "B" will prove its broad character and its adaptability for comprehensive and concise information on such instal-

lations as may properly be classed as agricultural.

When considering the advisability of extending transmission lines into a territory as yet, foreign so far as the use of electricity for the house, the barn, for irrigation or reclamation, some utilities endeavor to adapt the card as shown in "A," or some modification of it for use as a prospect card. That confusion is apt to result where legend only is the discrimination between business and the value of such uses of current as may appeal to the agriculturalist is desired. Such a record results in additional revenue to the central station by this data now available at the utility. It is evident that a broad gauge utility of this nature can never be classified as close-fisted but will thereby secure information as to prospective business or contracting with a rural consumer. It will foresee at once the necessity

"B"

FORM N 600

IRRIGATION OR RECLAMATION RECORD | DISTRICT..........

NAME.......... P. O. BOX..........

LOCATION TOWN.......... TOWNSHIP & RANGE..........

ROAD (LOCATED ON).......... ACREAGE..........

PLANTED TO.......... YEARLY YIELD, TONS..........

EQUIPMENT INSTALLED BY..........

H. P. MOTOR.......... PHASE.......... VOLTAGE.......... SPEED.......... MAKE..........

PUMP, TYPE.......... MAKE.......... SIZE.......... GALLONS PER MINUTE..........

SUCTION LIFT IN FEET.......... DISCHARGE HEAD, FEET.......... TOTAL HEAD, FEET..........

COST OF CURRENT PER YEAR.......... MINIMUM CHARGE..........

COST PER K. W. HR. FOR CURRENT.......... COST PER H. P. PER YEAR..........

AVERAGE HOURS RUN PER DAY.......... DAYS PER YEAR RUN..........

CURRENT SUPPLIED BY..........(COMPANY). DATE EXPIRATION CONTRACT..........

REMARKS..........

....

COMPILED BY.......... DATE..........

S. F. 4327

"C"

PROSPECT RECORD NO.......... | DIVISION..........

....

H. P. OF ENGINE.......... MAKE.......... CONDITION..........

FUEL USED.......... QUANTITY PER YEAR..........

FUEL COST PER GALLON DELIVERED..........

REMARKS ON PLANT..........

PUMP.......... TYPE.......... SIZE..........

REVOLUTIONS OF PUMP.......... SIZE OF PULLEYS..........

INSTALLED COST OF PLANT		OPERATING EXPENSES	
ENGINE, - - -	$..........	FUEL PER MONTH, -	$..........
PUMP, - - - -	$..........	LABOR PER MONTH,	$..........
INCIDENTALS, -	$..........	REPAIRS & SUPPLIES,	$..........
TOTAL COST,	$..........	TOTAL OPERATING EXPENSE,	$..........

TOTAL SEASON OPERATING EXPENSE, $.......... NUMBER OF DAYS..........

GENERAL REMARKS..........

....

REPLACED BY ELECTRIC SERVICE, DATE.......... (SEE OTHER SIDE)

revenue producing business contracted and in prospect, is evident and it is with a view of providing a comprehensive yet convenient prospect record card for agricultural business that the one shown in view "C" is illustrated. That such a record of prospective of an agricultural sales department, unhampered with the red tape of ordinary commercialism and with sufficient latitude in its expenditures as to plan and prepare some authentic information on the sales of current for agricultural purposes.

ELECTRICAL PUMPING AND IRRIGATION

DEPTH OF CUT FOR CANALS IN LEVEL GROUND.

BY B. A. ETCHEVERRY.

Equalizing Cut and Fill.

The cross-section of the canal and its slope being determined, the next step is to determine the depth of digging. This may be fixed so that most of the canal will be (1) within soil or all in cut; (2) above soil or all in fill; (3) partly in cut and partly in fill. In some case where the soil is pervious and not suited to make good banks, where the depth of water may threaten the safety of the canal, or where the canal is on a side hill, it may be necessary to keep within soil. Care must be taken, however, by sinking trial pits that a sandy stratum is not reached by deep cutting, as in this event much valuable water may be wasted by seepage and the waterlogging of the soil may affect the health of the country and ruin land.

Typical Dirt Ditch, Nevada.

In the second case, where the canal is all in embankment, there is always danger of breaks and consequent damage, and also the stoppage of irrigation when required. The embankments must be formed from outside borrow pits, which are always objectionable. This case has the advantage that the water surface is kept above the general level of the ground surface. However, this advantage is only of value for laterals; it will ordinarily suffice if the water level is kept 1.0 to 2.0 feet above ground level; there is usually no advantage in more than this.

The third case has several advantages, especially for canals in level land. When a canal is partly in cut and partly in fill, the water has usually sufficient elevation above the land to give good command into the distributaries, which permits easy application of water to the land. It is also the most economic canal, for the depth of digging can be selected so that the earth excavated from the channel will just suffice for the banks, due allowance being made for shinkage and waste.

The economic depth of digging in level ground can be obtained as follows:

Substituting the known numerical values the equation is readily solved for x.

Let d = total depth of canal section.
b = base width.
a = width of top of bank.
x = economic cut.
m : 1 side slope of water section.
n : 1 side slope of outside of bank.

$\frac{1}{2}$ area of excavation $= \frac{1}{2}\ (b + mx)\ x.$

$$\text{Area of one bank} = \frac{[\,2a + n\,(d - x) + m\,(d - x)\,]\,(d - x)}{2}$$

Assuming 10% for shrinkage and placing, or cut = 1.1 fill; then

$$(b + mx)\ x = 1.1\ [(2a + (n + m)\ (d - x)]\ (d - x)$$

$$bx + mx^2 = 2.2ad - 2.2ax + 1.1nd^2 - 2.2ndx + 1.1nx^2 + 1.1md^2 - 2.2mdx + 1.1mx^2$$

$$x^2\ (.1m + 1.1n) - x\ (b + 2.2a + 2.2nd + 2.2md) = -2.2ad - 1.1d^2\ (n + m)$$

Substituting the known numerical values the equation is readily solved for x.

Field Method of Balancing Cut and Fill for Canal Section in Side Hill. Pivotal Point Method.

When this method is used a stake is first driven at each station at a point where the ground elevation is equal to the elevation of the subgrade of the canal plus the economic cut for a level section and then moved up the sidehill a horizontal distance which will bring it on the center line of the canal and will give the proper balance between cut and fill for the sidehill slope. The purpose of the problem is to obtain the horizontal distance mentioned above. It is worked out for the following special conditions: (1) it is assumed that the uphill canal side slope is equal to the outer or downhill side slope of the bank; (2) it is for a one bank canal. The downhill side slope of the canal need not be the same.

Let
b = base width of canal section.
a = width of top of bank.
d = total depth of canal section.
m:1 = downhill side slope of the canal section.
n:1 = uphill side slope of canal and outer or downhill side slope of bank.
x = depth of economic cut for level section for one bank only.
y = distance from center line of canal to the point on the ground whose elevation is equal to the elevation of the sub-grade of the canal plus x.

The point M represents the position of the grade stake, whose elevation is equal to the elevation of the subgrade of the canal plus x, which is the depth of

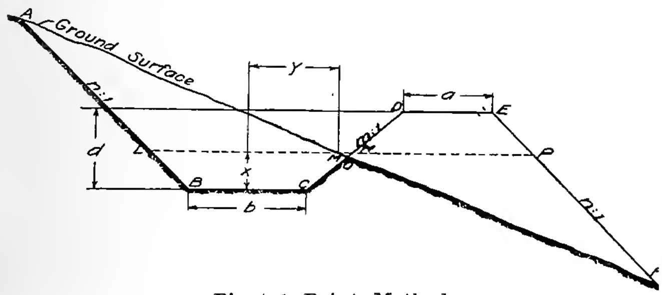
cut necessary in a level section to balance the fill, allowing for shrinkage. Assuming 10 per cent for shrinkage, and that cut LBCN = 1.1 Fill NDER. From this relation the depth of cut x is obtained in the same manner as in the previous problem. This value of x is used to locate the stake at M. The cut ALM must be sufficient to balance the fill ONPF, allowing for shrinkage, but as the triangle MNO is small it will be on the safe side and sufficiently accurate to assume cut ALM = 1.1 Fill. These two triangles are similar and their areas will be in proportion MPF to the squares of their corresponding sides. Therefore,

$$\frac{\text{tri}/ALM}{\text{tri}/MPF} = 1.1 = \frac{(LM)^2}{(LP - LM)^2} \text{ or } \frac{LM}{LP - LM} = \sqrt{1.1}$$

From which

$$LP = \frac{LM}{\sqrt{1.1}} + LM = 1.95\,LM \text{ or } LM = .514\,LP$$

Where $LP = b + (n+m)x + (d - x)(n+m) + a$; the distance from the center line to the point $M = y = LM - (b/2 + nx)$ or $Y = .514LP - (b/2 + nx)$. The value of Y remains the same for any given cross section and does not vary with the slope of the side hill. Hence when it is once computed by substituting in the equa-



Pivotal Point Method.

tions the values for the dimensions of the canal, it is used at all the stations unless the cross section is changed. The field procedure is to locate the point M at an elevation higher than the bottom of the canal by the economic cut for a level section from this point measure up the hill the constant distance obtained from the equation, this will establish the center line.

Profile of Canal Line and Grade Lines.

The profile of a canal line is obtained from the plot on profile paper of the elevations on the stations. On the profile is generally shown the sub-grade line, the high water line and top of the bank grade line. The difference between the ground elevation and subgrade elevation gives the depth of cut or fill at each station; this is used on the construction survey. On the ordinary canal profile, portions of the canal will be in cut, others in fill, others partly in cut and partly in fill. The profile is used to adjust or determine the grade lines and obtain the depth of cut or fill at each station. Its value depends on the method of location used and on the position of the canal. When the line is that of the diversion canal or of a canal on a sidehill located directly on the ground, without a paper location, such a location is based on the grade and cross section adopted before the survey and the use of the profile will be to permit of a closer adjustment of grades, changing them if necessary, and especially to obtain the cut and fill. When the canal is on sidehill and located by means of a paper location, the profile will be more useful than in the previous case to adjust the grades and cut so as to obtain a proper balance between cut and fill within the limit of economic haul.

When the position of the canal line is fixed by the topography, such as when it must be placed on a ridge or along a boundary line, which is often the case with laterals, then the determination of the correct grade and the proper adjustment of the subgrade line requires a careful study of the profile. If the slope of the country is exactly uniform and equal to the canal grade, then the best position for the subgrade line is parallel to the surface slope and at a depth below it equal to the depth of cut which will give a proper balance between cut and fill. Usually, however, there are more or less inequalities. The following cases often arise: (1) the grade of the canal is parallel to the average grade of the surface of the ground; (2) the grade of the canal is less than the average grade of the ground and it is necessary to use drops.

For the first case the procedure would be as follows:

(a) Draw the surface grade line which will coincide as much as possible with the ground surface. (b) Determine the suitable cross section for the above grade and compute the depth of cut so that the cut will equal the fill. (c) Draw the subgrade line parallel to the surface grade line, below it, at a depth equal to the depth of cut. (d) Draw the high water grade line and top of bank grade line.

For the second case the procedure would be:

(a) Determine suitable cross section, grade and velocity, the cross section and grade being largely determined by the desired velocity. (b) Fix the minimum depth of cut, obtain the average surface grade of the ground surface and find the most economic height of drop, as discussed later. (c) From the height of drop and the minimum depth of cut locate the subgrade on profile.

(To be continued.)

PORTLAND RATE ORDINANCE SUSTAINED.

Application of the Portland Railway, Light & Power Company to the United States District Court for an injunction to set aside an ordinance of the City of Portland fixing the minimum rates that may be charged by gas and electric companies was denied last week by Judge Bean, on the ground that the Federal Court has no jurisdiction in the matter.

In his decision Judge Bean said that since both the corporation and the municipality belong to the same state, there is no diversity of citizenship, and hence the court has no jurisdiction on that ground. Its jurisdiction is sought to be invoked, he says, solely because the provisions of the ordinance deprive the company of its property without due process of the law and impairs the obligations of unexpired contracts existing at the time of the adoption of the ordinance; but the averments of the complaint do not support this contention.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895.
Entry changed to "The Journal of Electricity, Power and Gas," August 15, 1899.
Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

A Progressive Franchise Policy

Out West one often hears, as in other places, an old saying about taking a horse to water "but you can't make him drink." No more forceful illustration of this can be found than that brought to light in an attempted one-sided regulation of the traffic problem in Western municipalities. Three parties, the harmonious working of which is essential, must be amply protected. Like the primary coils, the magnetic field, and the secondary coils of the transformer, the general public must so regulate the energizing field of force that people, labor, and capital, are interlinked by this field of progressive force—so that maximum energy is transmitted for minimum effort or expenditure. Indeed, a one-sided policy which unnecessarily hampers a utility in its efforts, or which demoralizes or lowers the standard of labor is to be avoided.

Many western cities now find their streets congested with traffic. San Francisco, for instance, has developed in its citizens a riding habit exhibited by no other city in America. Yet, under the present status, progress is impossible. No extensions of street railroads, gas or water pipes, or electric lines can be made. The existing companies, compelled to earn their capital plus profit before the date of franchise expiration, are forced into a selfish attitude, wholly unnecessary for the future good of the city. Amendment No. 34, drawn by three noted traffic experts, will be voted upon on December tenth. The provisions under the new regime are enabling and yet no overstepping of bounds will thereby be made possible. This enactment would provide in the charter the general terms under which municipal ordinances may later be prepared by the Board of Supervisors, subject to the referendum vote. There is also established the foundation for a comprehensive franchise or administrative code, defining in specific terms the conditions and limitations under which all new franchises may be granted by the city to private operators. Most important of all, however, the Board of Supervisors are empowered to carry out a comprehensive resettlement or adjustment franchise policy by means of which existing grants to private operators may be merged into those of new or adjusted grants, which contain specific conditions calculated to remove the present obstacles to adequate service and continued expansion. This amendment should by all means be carried, for if defeated the present stagnation in transportation adjustment must continue for at least two years more.

Amendment six is, on the contrary, wholly unnecsary. This proposed enactment calls for the appointment of a utility commission. We have repeatedly called attention to the mistaken and narrow-minded policy of municipal versus state-wide regulation. Elsewhere in this issue will be found a forceful paper by a Wisconsin commission expert on this self same point. In California a state-wide commission, proven by months of efficient service, now stands ready to meet every phase of the intricate problems before the util-

ity world in San Francisco. Such a state-wide regulation would make a harmonious blending for 1915. For the good of San Francisco in 1915—"now is the time and here is the place"!!

Electrical Equipment of Lift Bridges

Western activity in bridge design is fully apace with other gigantic engineering undertakings in that portion of America. The twenty million dollar bridge interlinking Berkeley, Goat Island and San Francisco will undoubtedly prove an impracticable dream, and even the proposed mammoth bridge crossing the Columbia at Vancouver may be in a somewhat nebulous state of imagination, and again the crossing of the Oakland and Antioch at Chipp's Island may still be unaccomplished, yet the past months have, nevertheless, actually seen the fulfillment of a world-beating feat in bridge design at Portland, Oregon.

Scarcely a bridge has not felt the additional burdens imposed by the concentrated loads incident to the modern automobile and rapid traffic growth in the West. The bridge just completed by the Oregon-Washington Railway & Navigation Company at Portland is the largest double-deck lift bridge in the world. It is the only bridge in existence having a movable lower deck. This pliability wonderfully simplifies traffic congestion which immediately takes place when undue raising of the upper deck becomes necessary.

The bridge has ample use for its two decks. The lower is used to supply double track connections to train service and the upper furnishes two sidewalks, two wagon roads, and double tracks for street cars. The tracks of the lower deck are laid over 6 by 8 in. wooden ties, which are placed on the top of steel girders, while the upper deck is paved with wooden blocks on four-inch planks.

The required government channel clearance is attained by lifting vertically upward a 250 ft. section of the bridge to a height sufficient to give 140 ft. clear space to the high water line. Since all vessels do not require such extreme clearances, remarkable ingenuity was employed in making the lower deck movable while the upper remains in place. Seventy per cent of the vessels passing require less than 70 ft clearance, hence continuity of city traffic is thus materially improved by allowing the upper bridge to remain in tact.

The electrical equipment plays no mean role in the ingenious operation of this world beating engineering structure. In case of breakdowns the control is arranged so that any one, any two, or all four motors may be connected in series or parallel. Suitable clutches are provided to connect the motors mechanically to either lower or upper deck. In case of breakdown, a double throw switch has the flexible possibility of connecting with the electric service supplied from either side of the river. Finally, as a last resort in case of accident, the bridge mechanism is provided with suitable levers so that hand operation is possible.

Excellent control is also installed for making the operation of the bridge fool-proof. The current cannot be turned on to the motors which operate the upper deck until the locks have been opened and the deck is free to rise. Again, the current cannot be turned on to the same span until the lower span is raised to its highest point and properly locked by the solenoid brakes on its motors. Limit switches also cut off the current when the limit of travel of the decks has been reached, and finally, signal lights automatically indicate the heights of travel. Definite governmental instructions are thus flashed to all observers.

The bridge made its first one thousand trips without requiring adjustments and today stands as a monument of enterprise to the city of Portland and a credit to all having a part in its construction.

Water in Fuel Oil

An article on methods of water determination for fuel oil, appearing elsewhere in this issue, recalls to mind the combustion losses due to presence of water in fuel oil, and the present status of processes whereby water in emulsion may be taken from the oil.

That water in fuel oil is not passive but, when appearing in certain proportions may be shown to be a formidable draw-back for efficient combustion in the boiler furnace, must be admitted. Let us, however, examine. Assume for instance that the fuel oil, containing 20 per cent water, either in the free state or in emulsion, is taken from the storage tank at 60 degrees F., and finally that the products of combustion leave the chimney at 500 degrees F. Evidently in the process of combustion of the oil this water must be evaporated into steam at atmosphere pressure and then superheated to 500 degrees F., all of which is at the expense of the heat given out by each pound of oil. Thus, to raise the temperature of a pound of water from 62 degrees F. to 212 degrees F. requires 150 B.t.u.; to evaporate into steam at atmospheric pressure requires an additional 970.4 B.t.u.; and, finally, to superheat to 500 degrees F., 135 B.t.u. must again be added. Hence, in all is required some 1255.4 B.t.u. Twenty per cent of this amounts to 250 B.t.u. per pound of fuel fired. California crude petroleum usually averages about 18,500 B.t.u. per lb. Hence there is wasted 1.5 per cent of the heating value of the fuel. This needless waste takes place, even if the far surpassing costs of transporting this surplus bulk, were neglected.

In almost all oil fields water-bearing strata are found either above, below, or sandwiched between the oil sands. To remove that proportion appearing as free water by simple gravity setting is an easy task. Water in emulsion, however, often running as high as 30 per cent of the mixture, is indeed a difficult problem of solution.

It is interesting to note that electricity has again solved this, another riddle, in the engineering world. Oil containing water in emulsion, when exposed to a highly attenuated magnetic field, forms a chain of globules or water drops, between the electrodes. Canvas is interposed, which—mirabile dictu—catches the water but is absolutely insensible to oil. Hence the segregation is accomplished. Thus is it made possible to sell more electricity in order to make more commercial oil, in order to generate more electricity—surely this is a forceful illustration of casting bread upon the waters.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

T. E. Bibbins has been reappointed Jovian Statesman at large by **Frank E. Watts.**

E. C. Hutchinson, sales engineer with the Pelton Water Wheel Company, is in Washington.

W. F. Lamme, consulting electrical engineer at San Francisco will visit Pittsburg and New York City within the next two weeks.

E. B. Bumsted, vice-president of the Oro Electric Corporation, has returned from a brief trip East and spent most of the past week at Oroville, Cal.

E. P. Edwards, engineer with the lighting department of the General Electric Company, and a specialist on the application of electricity to the farm, was in San Francisco during the past week.

W. E. Erwin, formerly assistant superintendent of the San Bernardino (Cal.) division of the Pacific Electric Railway, is now superintendent for the Santa Barbara Consolidated Electric Railway Company.

R. B. Clapp, representative of the Westinghouse Electric & Manufacturing Company at Los Angeles, has been appointed Statesman of the Jovian Order for Los Angeles by **Frank E. Watts** of New York City, Eleventh Jupiter.

Wilber E. Coman, at present general freight and passenger agent for the North Bank and affiliated railroads, has accepted the position of vice-president and general manager of the Northwestern Electric Company at Portland, Ore.

F. G. Baum, engineer in charge of the Pacific Gas & Electric Company's hydroelectric development at Lake Spaulding, spent the past week inspecting the Los Angeles Aqueduct, in company with **P. M. Downing** and **H. C. Vensano.**

C. Walter Jones, formerly sales manager with the Holophane Company, has been appointed commercial manager for the Utah Light & Power Company at Salt Lake City. He has returned to Salt Lake City after making a brief visit to California.

Cyril J. Atkinson, inventor and patentee of the Atkinson gas producer, has severed his connection with the Dornfeld-Kunert Company of Watertown, Wis., to become associated with Fairbanks, Morse & Company, who have been given the use of all his patents.

C. E. Patterson of the auditing department of the General Electric Company, is making a tour of inspection of the Pacific Coast. On his trip from Los Angeles to San Francisco he was accompanied by **R. J. Cash Jr.,** manager of the company's Los Angeles office.

W. Brewster Hall, Pacific Coast manager for Pass & Seymour, left San Francisco this week for a two months' trip during the course of which he will call on the trade in Southern California, visit the factory at Solway, N. Y., where communications may be addressed to him, and return in February by way of Seattle.

F. O. Dolson has resigned his position with the engineering department of the Pelton Water Wheel Company to enter the employ of the Pacific Power & Light Company of Portland in a considerably broader field. Many of the most successful power plants on the Pacific Coast give evidence of the high quality of Mr. Dolson's work and his new field of activity is one that will be greatly benefited by his services.

A. L. Menzin has opened an office as mechanical and electrical engineer in the Sheldon Building, San Francisco. In addition to his long association with the Tracy Engineering Company, Mr. Menzin had considerable experience in the East, also being a graduate from the University of California. He is well known as a contributor to the technical press, his articles displaying the most profound and penetrating thought. His many friends unite in wishing him success.

Frank N. Killam, for the past three years travelling representative of the Pacific States Electric Company in California, is the manager of the new branch which the company has opened at Seattle. **E. A. Norton,** formerly with the San Francisco house, is division sales manager, and **W. H. Ayden,** cashier and credit man. Practically the entire sales force of the Holabird Electric Company, which has been taken over by the Pacific States Electric Company, has been retained.

Stanley V. Walton, western chairman of the N. E. L. A. committee on Electricity on the Farm, has called a meeting for December 7th, at Fresno, Cal. **Frank W. Balfour,** district agent for the Southern California Edison Company at Pomona, has been appointed by S. M. Kennedy of the company, as his representative on this committee. Mr. Walton has also prepared a paper on "Electricity on the Farm" to be presented at the Oroville meeting of the Counties Committee of the California Development Board of the same date.

Warner M. Skiff, for three years assistant manager of the engineering department, National Electric Lamp Association, has been appointed manager of the engineering department of the Association to succeed **Glenn C. Webster,** who has assumed the managership of the Tungstolier Works of General Electric Company.

Among those attending the meeting of the Pacific Coast Electrical Jobbers' Association at Catalina Island this week are the following from the North:

W. Brewster Hall and wife,	H. E. Sanderson,
F. H. Leggett and wife,	E. B. Strong,
T. B. Hyde and wife,	J. A. Herr,
C. E. Wiggin,	F. N. Averill,
C. C. Hillis,	Garnett Young,
F. H. Poss,	C. L. Gilson,
Miles Steel,	T. E. Bibbins,
C. R. Dederick,	T. E. Collins,
H. V. Carter,	Frank Fowden,
R. J. Davis,	A. H. Elliott.
C. C. Hillis,	

In addition there is a large attendance of Los Angeles electrical men, promising to give one of the most successful meetings. Besides the usual trophies, Walter H. Seaver, Pacific Coast Manager for the American Steel & Wire Company, personally presented a handsome silver trophy to be awarded to the man making the highest aggregate golf score.

SPOKANE JOVIAN LUNCHEON.

At the regular luncheon of the Spokane Jovians on November 26 H. L. Bargion of the Washington Electric Supply Company, was chairman of the day, the speaker being Honorable W. J. Hindley, mayor of Spokane, who gave a very interesting and instructive address on the "Benefits of Organization." A discussion to prohibit liquor at rejuvenations, led by V. G. Shinkle of the Washington Water Power Company, resulted in a vote and the motion was passed, that it is the sense of the Jovian Order that there be a total abstinence of all liquor at the rejuvenation and banquets. Statesman C. R. Bean has appointed Mr. Haggenmiller, assistant purchasing agent of the Washington Water Power Company, as alternate statesman for Eastern Washington, and as a committee on rejuvenation, H. J. Tinkham of the Pacific Telephone Company, W. A. Davis, city electrical inspector, and Mr. Hungate, chief electrical engineer of the Inland Empire System. He also appointed H. W. Peterson as toastmaster for the banquet at the rejuvenation.

The following Jovians will constitute the degree team for Rejuvenation Night:

Jupiter—V. G. Shinkle, Washington Water Power Company.

Neptune—H. L. Bargion, Washington Electric Supply Company.

Pluto—J. H. Jamieson, Westinghouse Company.

Vulcan—S. E. Gates, General Electric Company.

Mercury—A. C. Haggenmiller, assistant purchasing agent Washington Water Power Company.

Hercules—W. A. Davis, City Electrical Inspector.

Mars—Milliard Sebern, Washington Electric Supply Company.

Apollo—R. S. Kemp, Washington Electric Supply Company.

Avrenrim—J. R. Mitchell, Doerr-Mitchell Electric Company.

H. Robsheit of the Westinghouse Company will preside at the piano that night.

The Rejuvenation and Banquet will be held at 7:00 p. m. on December 7th, in the main dining room of the Inland Club

MEETING NOTICES.

San Francisco Jovian Club.

The regular weekly luncheon of the San Francisco Jovlan Club was held on Tuesday, December 3d at Tait's Cafe, R. R. Alvord being chairman. The subject of the day was an illustrated lecture on Ornamental Illumination by C. R. Wallis. A drawing was held for an electric coffee percolator, Mr. Talent being the "lucky man." The newly appointed Statesman, A. H. Halloran, briefly outlined plans for the ensuing year and suggested that a discussion be held at an early date on the advisability of prohibiting liquor at future rejuvenations. This suggestion was adopted and the matter will be the subect of a discussion at an early meeting. The next meeting will be held on December 17th. All visiting electrical men are invited to attend.

Portland Engineers' Club.

The regular engineers' luncheon was held at the Portland Hotel, Tuesday, November 26. The chairman was H. G. Beckwith of the Portland Architectural Club. The speaker was E. P. Miche, superintendent of the Public Parks of Portland, Oregon. The subect of his talk was "Needs of a City as Regards Boulevards and Parks."

CALIFORNIA ASSOCIATION OF AUDITORS AND ACCOUNTANTS OF PUBLIC UTILITIES.

On Saturday, October 5, 1912, the California Association of Auditors and Accountants of Public Utilities was organized, with the following officers and board of directors: President, M. H. Bridges; Vice-President, B. T. Story; Secretary, H. E. Nowell; Treasurer, F. A. MacHugh.

Charter Members and Board of Directors: W. B. Bailey, Auditor Great Western Power Company; F. J. Blanchard, Auditor Sierra & San Francisco Power Company; M. H. Bridges, Auditor Pacific Gas & Electric Company; A. Herrick, Certified Public Accountant; W. E. Houghton, Auditor Los Angeles Gas & Electric Corporation; A. H. Kayser, General Auditor Spreckels Companies; A. Lambie, Pacific Coast Auditor H. M. Byllesby & Company; F. A. MacHugh, Special Accountant United Properties Company; H. E. Nowell, Auditor Oro Electric Corporation; C. P. Stall, Auditor San Joaquin Light & Power Corporation; B. T. Story, Auditor Southern California Edison Company.

This organization was the outgrowth of a committee appointed by the Railroad Commission of the above representatives of public utilities for the purpose of discussion of a tentative classification of accounts presented by the Commission for gas and electric companies. The benefits of each individual representative resultant from the various committee meetings and discussions held, demonstrated the benefits which would be derived from a permanent organization.

This committee was successful in presenting to the Auditor of the Railroad Commission definite recommendations as to the scheme of accounts proposed, and it was found desirable to perpetuate the common interests which may be taken up by a permanent organization.

It will be possible for this Association to hold meetings for discussion of papers presented by members, or have addresses made and papers read by visiting economists and accountants of national repute.

The effort of the present organization is to obtain a representative membership from all public utilities in California, inclusive of electric railroad companies, express companies, pipe line companies, gas companies, electric companies, telephone companies, telegraph companies and water companies; and to this end we have effected the above organization until the regular annual meeting held March 29, 1913, at which time the officers and directors for the ensuing year will be elected. It is hoped to have a representative directorate and official body elected at this meeting. This meeting will present an opportunity for the participation of all new members within a few months of the organizing of the association and will have the effect immediately of presenting a policy and program of the association outlined by a majority membership.

As the qualified membership represented at the annual meeting will be limited to those members who have been accepted by the board of directors prior to March 29, 1913, the date of the annual meeting, it is desirable that the membership be as complete as possible by that date, in order that the 1913 program may be outlined by a representative body and provide immediate working funds.

CONFERENCE ON WATER POWER REGULATION.

John M. Eshelman, president of the California Railroad Commission, has returned to San Francisco from a national meeting of railway commissions and from a conference with Secretary Fisher of the Department of the Interior. A two-days' conference was held with representatives of some of the large power companies on November 18 and 19, Prof. Chas. D. Marx of the California Water Commission, also being present.

Representatives of the power companies urged the policy of local rather than federal control. Secretary Fisher favors the distribution of the benefits of natural resources to the ultimate consumers in the form of lower rates and better service. Where steam competition is not present and competition between waterpower sites is abolished, effective regulation of the resulting monopoly is quite possible, but, in his opinion, the power to charge rentals should be preserved to the federal government because defective state laws or lax administration may fail to protect the public from extortion.

The new regulations insure state control of rates and service by a provision that failure to obey reasonable requirements made by state authorities shall be deemed adequate cause for revocation of the federal permit.

There was some criticism of the details of the regulation which binds the permittee to sell at a fair valuation to the state or any municipality desiring to purchase, but the correctness of the general principle was admitted. The desirability of some impartial and effective method of determining valuation in such cases was conceded by the federal officials. Secretary Fisher said that his department approves of the general provisions of the pending Burton bill to regulate waterpower development on sites owned by the federal government and considers them consistent with the regulations under discussion and in accord with the views generally expressed at the conference. He also requested specific criticism of the measure before the Interior Department responds to the formal request from the Senate committee on commerce for report thereon. It is believed that one outcome of the conference is likely to be simplified procedure, whereby state and federal officers will act in harmony and with dispatch.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

THE RELATION OF THE OREGON ELECTRICAL CONTRACTOR TO THE UNDERWRITERS' INSPECTION WORK IN OREGON.[1]

BY F. D. WEBER.

When Thomas Edison invented the incandescent lamp in 1880 a new era was immediately opened in the illuminating field. The present day electrical contracting business was then born as a direct result of the inventions that made electricity practical and a necessity. Afterwards it seems to have drifted along for years as a part of this wonderful development, but without any specific effort being made to raise its standard as a business until the National Contractors' Association was formed.

The business within itself is as diversified as is possible to imagine. The individual contractor's scope varies from the "carpet bagger" to the great power plant contractor and builder. Therefore is it any wonder that it is a most difficult task to bring this diversified group into one organization and establish ideals for them and have these ideals become well rooted in such a short space of time.

The electrical contractor must have ideals. He must have instilled a burning desire to raise the standard of "electrical contracting." This desire must come from within the heart of every contractor and be never laid aside for a second. Just as soon as the contractors of Oregon are in "dead earnest" and announce that they mean business immediately the tide will turn in their favor and a new era will be with us.

We all know that in the past the electrical contractor has always received the worst of the deal. Starting from the specifications written by the architects and continued by the superintendent on the job, he is given about as little consideration as is possible to conceive.

During all these thirty-odd years, there has always been organizations in this country which have been staunch friends to the electrical contractor as long as he endeavored to follow a legitimate course. These organizations are the various Underwriters' organizations throughout the United States.

The Underwriters' attention was forcibly called to the necessity of electrical inspection as early as 1881, due to the fact that twenty-six electrical fires occurred in six months in the sixty-five textile mills of New England. They immediately formulated local rules to handle the situation, from which grew the N. E. C. as we have it today, being first adopted as such in 1896.

Therefore the National Electrical Code is the product of early and continued cooperation in the early days of electricity between the various electrical and insurance interests, and has been so well guided as to be today the most widely accepted material standard in the world and the code of specifications most widely incorporated into ordinances. Therefore you see the Underwriters have endeavored by the aid of all other national organizations to set a standard below which no workmanship or material should fall.

Nothing is said as regards exceeding this standard in perfection, consequently the electrical contractor has the liberty to approach perfection as near as he desired, but it is astonishing to see how little thought is expended by him in striving to exceed this minimum standard.

In connection with the N. E. C. there is maintained in Chicago the Underwriters' Laboratories, Inc. No other country has the benefit of a system like this. The Canadian Underwriters are now using the laboratory reports as their authority on material and fittings. The laboratories are now dispensing labels at the rate of 20,000,000 per annum.

There has never been any organization except the Underwriters in this country which has ever taken decided steps to advance the standard of materials and fittings. Do you ever hear the jobbers say we will not handle a fitting or a material, because it is not the best one we can get. They only stop when the Underwriters refuse to pass them and many times they handle it on the quiet, anyway. You must remember the Underwriters are in business too, and many times lose business by an increase in insurance rates, still you will find that all over the United States they are willing to sacrifice the business, when they are sure they are in the right.

The methods the Underwriters have used in the past in Oregon are quite clear to a great many of you, i.e., An inspector will visit a town or city, go through all the business risks and any special risks—such as saw mills, flour mill, etc.—and make a list of all electrical defects. Then when he returns to the office all the owners and tenants are notified by him in writing. Then after a reasonable time, over 30 days, the town is re-inspected, and if no attempt has been made to correct the defects a readjustment of the insurance rate is made, generally 25 per cent increase. Moving picture booths construction are also inspected and charges made for defective installations.

If at any time after the increase in the rate the inspectors had received a letter, or in other words a certificate, stating that the defects had been corrected according to the requirements of the N. E. C. the rate is reduced, subject to an inspection by this office. This certificate should have been made out by the local city electrical inspector, or in the absence of this official by some person connected with the electrical contracting business, or representatives of the power company. Printed reports in all towns and cities were sent to all the managers of the various insurance companies.

After the Board of Fire Underwriters of the Pacific withdrew from Oregon, country inspection was discontinued for about two years, but beginning with the first of this year we have again commenced this work under the new organization, known as the U. E. R. Bureau. Our old system was unsatisfactory from our own standpoint and from the standpoint of the owners, tenants, and electrical contractors. Consequently in the last year we have been endeavoring to develop a new system of inspection, and after investigating the systems used in the older jurisdiction believe we are now on the right road and have devised a system which will be thoroughly satisfactory.

The things to consider in devising a system of inspection are the following:

(1) The amount of labor required to place the defects under a system—in field and in the office.

(2) Flexibility of the system as regards addition of new defects and the addition of new buildings in the town and cities inspected.

(3) Simplicity of the office system, so that anyone in our office, not an electrical engineer, can find the defects on any risk.

(4) Simplicity and ease of understanding for the layman, as well as for the electrical contractor.

(5) Avoiding mistakes on the part of the layman and contractor, by double meaning being attached to any defect pointed out.

[1]Paper to be presented at the Oregon Electrical Contractors' Convention, Portland, Oregon, December 17 and 18, 1912.

(6) Return of a proper certificate of correction, signed by the proper party, as we do not accept owners' or tenants' signatures on same.

(7) Ability of formal notice to make the proper impression on owners and tenants and get the corrections made immediately without forcing same by rate adjustment.

(8) A method of protecting owners and tenants from the operation of crooked contractors by having the contractors' statements of proper correction in writing.

(9) Division of responsibility between the contractor, local city inspector and bureau inspector for proper correction.

(10) A means by which to adjust rates without inspection, thereby giving honest correction of defects the advantage of the best rate possible, and at the same time not nullify our original notice.

(To be continued.)

CONDUIT CONSTRUCTION.

It is very evident that the tendency of the times on the part of architects, engineers, inspection departments and municipal authorities is toward the requiring of metallic conduit for the installation of wires in buildings.

Recognizing this tendency the National Electrical Contractors' Association, through its executive committee, has been working on the preparation of reliable data in regard to the proper size of conduit to be used in installing wires and cables.

The disposition in the past has been to use conduits of too small interior diameter, and in the preparation of these charts care has been taken to recommend conduits of sufficient size to cover all their conditions, and at the same time having in mind that the economy in installations should be considered and extravagant sizes in conduits not recommended. We therefore, feel that the sizes recommended are sufficiently large and at the same time conservatively calculated.

Very nearly a year has been spent in the study and investigation of this subject, and this has resulted in the preparation of charts showing in full size the proper sized conduits to be used for installation of various combinations of wires and cables, and those charts were officially adopted at the Twelfth Annual Meeting of the National Electrical Contractors' Association.

The charts show the conduit and conductors in full size, and the prints are made from plates so that there can be no variation in size, and the sheets are mounted on heavy board with an eyelet at the top for convenient hanging.

In addition to showing the size conduit needed for such combination of wires, the charts give the actual external diameter of the conduit, and the carrying capacity of the wires shown.

The complete set comprises six charts, and shows the proper size of conduit for one, two, three, four convertible three-wire systems; combinations of duplex wires in sizes No. 10, 12 and 14 B. & S. gauge; single wire combinations of No. 14 B. & S. wire up to ninety wires; combinations of No. 16, No. 18 B. & S. fixture wires up to one hundred and fifty wires, and combinations of telephone wires up to fifty pairs.

This covers practically all of the data required for the installation of wires and conduits, and presents it in a form most convenient for use.

The advantage of a standard system is self-evident from the standpoint of the architect, engineer, and contractor, and it is the hope of the National Electrical Contractors' Association that those having to do with the installation of conduits will accept the charts as prepared and write into their specifications that, "the sizes of all conduits shall be the N. E. C. A. standard."

The National Electrical Contractors' Association has borne the work and expense of the preparation of these charts and in the interest of standardization is prepared to furnish these charts at the actual cost of producing them, and will forward a set securely boxed f.c.b. Utica, on receipt of $2.25. Orders for them or requests for further information should be sent to W. H. Morton, Secretary, 41 Martin Bldg., Utica, New York.

SAN FRANCISCO ELECTRICAL CONTRACTORS' NOTES.

The Standard Electric Company was awarded the wiring for the Starr King school for the sum of $1924.

John G. Sutton Company has nearly completed installing the feed wires for the Geary street road.

The Buyers' Reference Catalogue that is being gotten out by the committee appointed by the contractors, will be mailed at the end of next week. Anyone desiring one of these books can obtain same by notifying W. S. Hanbridge, 1408 Merchants' National Bank Building.

President John Rendler and Secretary W. S. Hanbridge held a meeting in Fresno November 29 and took up several matters of importance to the State Association.

The draft of the state license law will be placed in the hands of an attorney so that the same may be in proper shape to present to the legislature in January. Assemblyman Scott will present the bill to the Assembly.

The matter of extending the conduit ordinance throughout the city, which was presented by the Contractors in August, was taken up by the Building Committee Tuesday. Messrs. Hanbridge, Watts and Deleiu represented the Contractors; Messrs. Brumfield and Porter the sign men; Messrs. Nixon and Fish the Department of Electricity, and G. I. Kinney the Electrical Development League. At his request the matter was taken under advisement by the Building Committee. The principal reason the Contractors are anxious to get conduit throughout the city is because at the present time they are required to run wires in conduit in all buildings in the fire district. The result is no job of wiring can be done at the present time without the use of some conduit, thus bringing the average up to about 75 per cent of the work installed in conduit at present.

SOCIETY FOR ELECTRICAL DEVELOPMENT, INC.

New York City, Dec. 4. 1912.—The Organization Committee for the Society of Electrical Development, Inc., met at New York City on December 2. Considerable progress in development plans was reported, but the variety of interests to be considered still necessitate a great deal of work by the committee before the suggestions will be concrete enough to present to the industry at large. A sub-committee on finance and administration for further organization work was appointed. Sufficient funds were advanced by members of the organization committee for this purpose. The next meeting will be held in January.

EDITORIAL NOTES.

In connection with S. M. Kennedy's articles on "Justification of Rate Regulation" as published in these columns last week, mention should have been made that this had been read as a paper before the employes of the Southern California Edison Company as it relates simply to local conditions and is intended to be general in its scope.

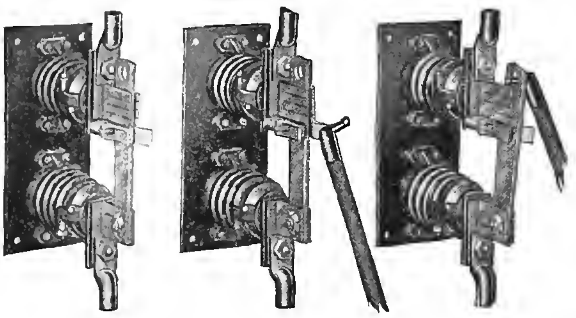
In connection with H. J. Kennedy's article on "Woodstave Pipe Construction" in the issue of November 9th, on page 403, the price of coal should have been stated as being less than $4.00 a ton instead of less than $3.00 a ton.

INDUSTRIAL

SAFEGUARDING CONTINUITY OF ELECTRIC POWER SERVICE.

At the present time, the ubiquity of electricity is practically an accomplished fact. To realize how dependent the people are upon the electric current, it is only necessary to be at the power house end of the telephone when the power is off and an exasperated public has waited for what they consider a reasonable length of time for its restoration. A shutdown of the machinery may mean not only serious delay in finishing work, but also men paid high wages standing around idle. This condition makes it imperative that every device be employed which makes for continuity of service.

The illustration shows a locking device, manufactured by The General Electric Company, that effectually prevents the blade of a disconnecting switch from opening except under the direction of the operator. Instances are on record where the blade of a disconnecting switch not protected by this device has been thrown open or partly open by magnetic repulsion and destroyed when a short circuit has occurred on the line, not only resulting in the loss of the switch, but also putting the circuit on which the switch was installed out of commission till a new switch could be installed, unless there were duplicate circuits.



Disconnecting Switch with Locking Device.

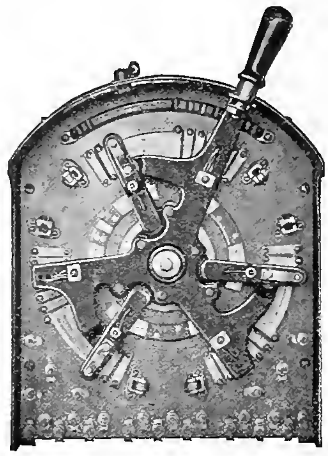
The safety catch or locking device is a unit in itself and can be applied by anyone to any GE type L, for G-6 switch merely by clamping it to a support placed between the clip block and the insulator cap. It is of rugged design and is operated with a switch hook. This locking device consists essentially of two brass bell cranks hinged together at the ends of the two shorter arms and held closed by compression springs. The projections or jaws in the outer ends of the two longer arms close in front of the blade, thus preventing the latter from coming out of the clips. Each bell crank is provided with a dog which moves in a slot in the bell crank's elbow, the dog being hinged at this point. Two compression springs, one pressing outwardly from the switch base against the elbow of each crank and also against the dog, keep the bell cranks closed and the dogs pressed against the back of the switch blade.

To open the switch the outer ends of the bell cranks are pressed back away from the blade, allowing the dogs to come forward so as to rest upon the sides of the blade, in which position they hold the jaws in front of the blade apart, allowing the switch to be opened. Withdrawing the blade of this switch from between the dogs causes the jaws to automatically close against the sides of the blade and to snap shut as soon as the blade is completely withdrawn.

As the outer edges of the jaws are beveled, the switch blade can be readily pressed back in the clips into the closed position, when the jaws close automatically in front of the blade, locking the latter in the closed position.

NEW CUTLER-HAMMER PRINTING PRESS CONTROLLERS

Direct-current types of the Carpenter type printing press controllers have long been widely used for the control of flat-bed presses. For use where alternating current only is available, the Carpenter type controller illustrated in the accompanying view has been developed and placed on the market by The Cutler-Hammer Manufacturing Company, Milwaukee. It is suitable for the speed control of slip ring induction motors driving printing presses, machine tools, etc. These controllers provide for seven forward speeds and two reverse speeds. They are suitable for either three-phase, three-wire, or two-phase, either three-wire or four-wire motors having



A.C. Printing Press Controller.

three-phase rotors with secondary current not exceeding 60 amperes per phase. Standard designs allow for 50 per cent speed reduction under full load conditions.

The mechanism is enclosed in a rugged cast iron case with a removable cover. The operating handle projects from a slot in the top of the enclosing case and provides easy means for operation. The terminals are easily accessible.

The resistance, except in the cast of the 7½ h.p. size, is all contained on one plate divided into three sections, so that speed variations are obtained by inserting equal amounts of resistance in the rotor circuits. The Carpenter resistance plate can be installed under the press or machine without danger.

BOOK REVIEW.

Questions and Answers on the National Electrical Code. By T. S. McLoughlin. 232 pages, leather-bound pocket-book. Published by McGraw Hill Book Company, New York, and for sale by Technical Book Shop, San Francisco, Cal. Price, $1.00.

This manual is written as a guide to the National Electrical Code for the use of wire men, contractors, architects and engineers. It is arranged as a series of questions and answers, each answer being followed by the number of the corresponding code rule upon which it is based. The book is divided into nine sections so that it is possible to get all the rulings on any subject under that heading. These are as follows: Generators, transformers, outside work, signalling systems, arc lamps and series systems, inside work, electric railway systems, marine work, code requirements on wire and material. This is an excellent start along the right direction. But as it is somewhat difficult, perhaps, to give positive answers to many of the questions, it would have been well to have qualified the bare "yes" or "no," which is frequently employed. The text will prove of great assistance to electrical contractors.

NEWS NOTES

ILLUMINATION.

EL CENTRO, CAL.—A franchise has been granted here to the Imperial Valley Gas Company to construct and maintain for a period of 50 years, a system of gas pipes.

LOMPOC, CAL.—Messrs. Weber & Wagner of Los Angeles, representing a group of capitalists, have applied to the town board for permission to construct and operate a gas plant here.

OAKLAND, CAL.—As a step in carrying out the plan to light East Fourteenth street, with electroliers or gasoliers from Central Oakland to the city limits beyond 107th avenue, the city council has authorized the placing of 34 gasoliers between 82d and 98th avenues.

TROPICO, CAL.—Sealed bids will be received up to January 2d, for a franchise granting the right to lay a system of pipes and pipe lines for a period of 40 years, in and under the public streets of Tropico, together with right to furnish gas through said pipes for that period.

PENDLETON, ORE.—Pendleton will not have a municipal power and light plant in the near future, all plans to acquire a power site on the Walla Walla river having been abandoned, when the council voted to return the option which it has held for the past half year.

LAS VEGAS, N. M.—The city council accepted plans of the proposed contract of the Las Vegas Light & Power Company, providing for a new system of street illumination. According to W. P. Southard, manager for the power company, the new lamps will be installed by January 1.

ANTIOCH, CAL.—An application has been made by the Great Western Power Company for a franchise to erect lines, wires, etc., for the transmitting of electricity in the town of Antioch, for furnishing light, heat and power. Sealed bids will be received up to January 13th, for the sale of said franchise.

TELEPHONE AND TELEGRAPH.

CARPENTERIA, CAL.—It is understood that the Sunset Company is planning to install a fully equipped central office here within 90 days.

LOS ANGELES, CAL.—Utilities board has taken under advisement the application of the American District Telegraph Company for a franchise to lay conduits in the city streets.

SOUTH PASADENA, CAL.—The Home Telephone Company has announced proposed improvements which include the installation of about 100 miles of cable in this city, and the removal of all duplicate poles.

SAN JOSE, CAL.—The town of Mountaiu View has sent to the Railroad Commission an order of the Pacific Telephone & Telegraph Company establishing Los Altos, two miles away, as a long distance station and charging for switches. Mountain View's switching privileges have always been limited to a short distance in the surrounding country, while Sunnyvale, its neighbor, has free local service as far as San Jose. Los Altos is to have a switchboard and will be a long-distance toll station.

SAN DIEGO, CAL.—Work on excavation for the conduits which are being put in by the Pacific Telephone & Telegraph Company and will extend from Seventh to Twenty-fifth street, has begun, about 150 men being put to work on the job. The new underground line will be a 6-duct conduit and each will carry 600 pair or 1200 wires enclosed in cables. The cost is estimated at about $23,000. When this work is completed, a 4-duct conduit will be laid from University to El Cajon avenue, to carry 1200 wires each, or 4800 in all.

SAN FRANCISCO, CAL.—An affidavit purporting to divulge the internal transactions marking the merger of the Pacific Telephone & Telegraph Company with the Bay Cities Home Telephone Company, and containing allegations of a corporation which existed for two days only and of the burning of records of the Home company, was brought to light Saturday, but disappeared later in the day. The document was signed by E. C. McDonough, who set forth that he was vice-president of the "Home Long Distance Company," the corporation mentioned. It was first offered as an affidavit before Judge Trabucco, who is sitting for Judge Lawlor in the injunction suit brought by O. L. Scott against the Pacific company to prevent it from dismantling the plant of the Home company. Trabucco rejected the document on the ground that it had not been offered in time. Then it was introduced in the office of the county clerk, where it was placed for filing, but was withdrawn later in the day before it had become a matter of record. Judge Trabucco took the injunction case under advisement, promising a decision at an early date.

TRANSMISSION.

NEW WESTMINSTER, B. C.—The city council will receive tenders from the Western Canada Power Company and the Vancouver Power Company, until December 23, for supply of power for this city.

CONCRETE, WASH.—The Northwest Traction Company has been granted a 50-year franchise to construct and maintain power wires through this city. The concern named will furnish power for the Washington and Superior Portland Cement Companies.

SATSOP, WASH.—The Montesano Light & Water Company and the Elma Light Company have petitioned the county commissioners for a permit to run an electric line along county road to Satsop and upon streets of the town. The matter comes up for final hearing December 2.

SAN BERNARDINO, CAL.—Plans are about completed by Pacific Light & Power Company to build a 60,000 volt power line direct to San Bernardino from its big distributing station at Eagle Rock. The line will be built on Base line eastward to A street, forming a loop of the valley, it being proposed to extend the line south to Colton, Riverside and then west to Dominguez near San Pedro.

TONOPAH, NEV.—For the second time in three weeks the substation of the California-Nevada Power Company here was burned out Saturday, shutting down all mines and mills. The damage is estimated at $20,000. The first fire was caused by a short circuit in one of the converters. Repairs had been practically completed when a workman dropped a piece of wire netting across a high tension power line.

TRANSPORTATION.

SAN DIEGO, CAL.—The San Diego Electric Railway Company has been granted a franchise to construct a street railway upon certain public streets in this city.

COEUR d'ALENE, IDAHO.—The freight depot of the Spokane & Inland Railway Company electric line burned here recently. Loss nominal. The depot will be rebuilt immediately.

SAN BERNARDINO, CAL.—The last deeds for the right of way for the Pacific Electric's Riverside-San Bernardino line have been filed for record, and construction work is expected to commence this week.

SEATTLE, WASH.—The Puget Sound Traction, Light & Power Company proposes to extend the Madison street car line from Broadway to Fourteenth avenue at a cost of approximately $125,000. Work will begin at once.

VANCOUVER, B. C.—Chief Engineer Conway of the British Columbia Electric Railway Company, is having plans drawn for a $30,000 station to be built at the south end of the Granville street bridge to serve patrons of the Eburne interurban lines.

EL PASO, TEXAS.—The Stone & Webster Corporation of Boston and the El Paso Electric Railway will be presented with franchise and deeds for the right of way for interurban electric railway to Ysleta, which will ultimately run east from El Paso in the Rio Grande valley. Construction work will begin as soon as possible.

ROSLYN, WASH.—Simon Justham, promoter of the Kittitas Railway & Power Company, is authority for the statement that the concern named will start actual work of constructing the proposed electric line from Cle Elum to Cle Elum mining district in the spring. French capitalists in Paris purchased bonds in the sum of $2,400,000 to finance the project.

LOS ANGELES, CAL.—It has been announced by Pacific Electric officials that the contract for grading the roadbed for the Pacific Electric extension from San Bernardino to Riverside by way of Urbita and Colton has been awarded to Robert Shereer & Company of Los Angeles, and the contract for bridge construction to Charles W. Corbaley of Los Angeles.

SAN FRANCISCO, CAL.—A special fund into which shall be paid all receipts from the Geary street road has been created by the supervisors. The first contribution was $10,000, transferred from the municipal railroad bond fund. This was set aside by the finance committee, at the request of Superintendent Cashin, for initial equipment and operating expenses. As soon as the railway is earning money the $10,000, which is in the nature of a loan, will be paid back into the bond fund.

SAN FRANCISCO, CAL.—Some time ago the Southern Pacific Railroad ordered fifteen 50-ton electric locomotives to be used for freight and switching service. The first one of these locomotives has just been completed. They are equipped so that they may be operated on either a 6000 or 12000 volt direct current, and if necessary they can be used for passenger service as well as for freight and switching. The Baldwin Locomotive Works built the mechanical parts at its Philadelphia plant and the Westinghouse Electric & Manufacturing Company constructed and installed the electrical equipment at its East Pittsburg works.

VALLEY SPRING, CAL.—It is understood that capitalists of San Francisco have become interested in the electric line surveyed from Mokelumne Hill to this point via the W. B. Clark marble quarry. Clark, it is understood, will back the movement for a new line and the survey party says other moneyed men will invest. C. A. Westenberg of San Francisco has recently been over the route and was favorably impressed with its possibilities. The rights of way have been secured over the greater portion of the route and work is in a position to be rushed along. The proposed line traverses a rich mining and timber district.

OAKLAND, CAL.—A crosstown line on Peralta street from Seventh to Fortieth streets, and a suburban ferry service, that will connect Fourteenth-street points directly with the Key Route pier through the extension of the Fourteenth-street line westward to the Key Route basin quay wall, are improvements on which the West Oakland Improvement Club are working, with promise of assistance from the Oakland Traction Company and the Key Route system. The extension of the Fourteenth street car line to the new municipal wharf has long been in contemplation, and it is now proposed by the people of West Oakland that the city administration grant the necessary permission to the traction company.

OAKLAND, CAL.—By the first of July trains will be operating between Sacramento and Oakland according to General Manager Napthaly of the Oakland, Antioch & Eastern Railway. Work is being rushed on the new line, and all indications point to the completion of the road by next summer. Contracts for the grading between Sacramento and a point about five miles from Chipp's Island will be completed by next week aud the remainder of the grading will be finished by January 15. The ferryboat to be used by the company for transporting passengers across Suisun Bay will be completed by the time the road is ready, and will be used until the bridge is built. Four piledrivers are now at work building the ferry slips on either side of the bay. The contract for the construction of the short stretch of road between Bay Point and Antioch will probably be let this week.

WATERWORKS.

BISHOP, CAL.—The Trustees have awarded the contract for supplying material for the water system to Leece & Waterson.

SUISUN, CAL.—At a special election held here the proposition of issuing bonds in the sum of $20,000 for the improvement of the municipal water system carried.

LOS ANGELES, CAL.—Representatives of the Domestic Water Company from Los Angeles, called on the city trustees recently and presented the proposition of selling its private waterworks to the city for $54,000.

SAN DIEGO, CAL.—The council has set the last Monday in December as the day of sale of the $2,500,000 bond issue which was recently voted to purchase the system of the Southern California Mountain Water Company.

FREEWATER, ORE.—The city council has passed an ordinance providing for the submission to the qualified taxpayers of the city the question of bonding the city in the sum of $12,000 for the purpose of repairing the city water system.

FARMINGTON, WASH.—On opening bids for the sale of the bonds of the town of Farmington to the amount of $10,000 for the construction of a municipal waterworks system, it was found that Carston & Earles of Seattle were the best bidders.

EL CENTRO, CAL.—The First National Bank was the successful bidder for El Centro extension bonds voted last September on its bid of par, $40,000, and accrued interest from September to date of issue. The sale of the bonds means the extension of the water system to portions of the city that await the coming of municipal water.

WINNEMUCCA, NEV.—The big ditch which has been constructed by the Humboldt-Lovelock Irrigation Light & Power Company at Mill City has been thrown open and now is carrying a full load of water. The dam is across the Humboldt River near Mill City and carries the water from the river a distance of about ten miles distributing it to farms in the Lovelock Valley. Natural storage reservoirs near Humboldt house will hold the water in the early spring for use during the summer season. The project will be practical operation next season.

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Devoted to the Conversion, Transmission and Distribution of Energy

Volume XXIX SAN FRANCISCO, DECEMBER 14, 1912 Number 24

MODERN STREET LIGHTING[1]

BY C. R. WALLIS.

A brief study of the "Proper Application of Modern Units to Street Lighting" suggests the necessity of defining in general terms what is meant by "Proper Application." Is the value of a unit determined solely by the electrical or lighting efficiency, and is the foot-candle illumination produced on the street surface the only factor to be considered in its application? If so, we can readily see that the problem would be to produce the maximum foot-candle intensity irrespective of physical, physiological or esthetic effects, which is obviously an error, and would be on a par with the early attempts at street lighting that can be summed up in the phrase, "Maximum light for minimum cost."

Graphic Comparison of Illumination With Inverted and Pendant Type Arc Lamps at State Capitol at Sacramento, California.

A consideration of the facts point out that "proper application" can only be defined in terms of effect produced. One authority states that "The ultimate goal of the illuminating engineer is psychological. He strives, with the highest attainable degree of efficiency, to produce desirable visual experiences in those whom he serves." The successful installation is marked by the Illuminating Engineering "finish," which reconciles intensity and distribution with artistic effects, eliminates glare and adds "tone," so we have one harmonious whole, with the lighting units and their field perfectly blended. In other words, the system produces the "ensemble effect" for which it was designed.

In approaching the problem of laying out a system, we must consider the surroundings and the characteristics of the units, or combination of units, that adapts them for this particular field. We must recognize the fact that units of entirely different types cannot generally be used, with good results, in close proximity, due to contrasts in light characteristics.

Since the object to be attained—the effect desired—will vary in different fields, it will simplify the subject to treat it under several distinct classes or groups, as suggested below.

First—General commercial street lighting in business districts of large cities.

Second—The outlying and residential street lighting in large cities.

Third—General street lighting in small cities and towns.

Fourth—Ornamental or display lighting.

Fifth—Park lighting.

Sixth—Parkway and boulevard lighting.

Modern Units.

To meet the requirements of the above fields, there are available the following units:

I—4-ampere d.c. Magnetite lamp, consuming approximately 300 watts (principally series) in:

[1]A paper read before the San Francisco Section of the A. I. E. E., October 25, 1912.

a. Pendant type for general street lighting—most of light in lower hemisphere—maximum ray approximately 10 degrees below horizontal.
b. Inverted type for ornamental lighting in small cities and for residential lighting.
c. Parkway type for boulevard or roadway lighting.

II—6.6-ampere d.c. Magnetite lamp, consuming approximately 500 watts (principally series) in:
a. Pendant type for general street lighting—most of light in lower hemisphere—maximum ray approximately 10 degrees below horizontal.
b. Inverted type for "Great White Way" lighting.

III—Long life flame arc lamps (450 watts up), for a.c. or d.c. multiple or series.

IV—Tungsten filament incandescent lamps in a variety of sizes for multiple and series service.

All of the above units can be furnished with various combinations of glassware and reflectors, thereby giving a wide range of adaptableness.

Characteristics of Units.

Since the characteristics of a unit have an important bearing on its field of application, comparative approximate data on the more important features is of interest.

Type of Lamp.	Color.	C.P. in Max. Beam.	Total Light per Watt M. Sph. C.P.	C.P. per Watt 10 degrees Below Horiz.
250 Watt Tungsten Filament Lamp....	Yellowish White	270	.61	.98 (24" Radial Wave Refl.)*
4 Amp. Magnetite Lamp	White	690	.95	2.23
6.6 Amp. Magnetite Lamp	White	1650	1.36	2.86*
10 Amp. A. C. White Flame (Approx. 500 Watts)	White	1700	1.58	2.62*

*Greater candlepower from 20 degrees to 40 degrees below horizontal.

The above data, with photometric or polar curves, will be useful in determining the type of lamp and the proper height and spacing for specific cases. From the polar curves can be plotted foot-candle curves which will be valuable in readily showing the intensity of illumination at various distances from lamp when mounted at a predetermined height.

Points to Be Observed in Selecting and Mounting Units.

The first, second and third divisions or classes come under the caption of commercial or general street lighting. The many miles of streets that must be served in our American cities, without undue partiality, necessitates efficient and economical means. In the majority of cases the unit must be located at street crossings. However, the modern unit, with superior characteristics, when properly selected and installed, will carry us past the first stage of "merely light."

The major part of general street lighting is of necessity low intensity. To meet the economical demand an efficient light producer must be utilized.

The practical efficient units available have high brilliancy. Extreme brilliancy in the line of vision causes the pupil of the eye to contract, and leads to eye fatigue, thereby reducing the effectiveness of the illumination. Herein enters the physiological demand for properly installing and modifying the high brilliancy units we must use.

I.

(a) For general lighting in principal business streets of large cities select large unit, with most light thrown in lower hemisphere and maximum rays, delivered at slight angle below horizontal. A fair intensity of illumination is necessary to facilitate handling of traffic.

View of Lighting on Hill Street, Los Angeles, With 4-Ampere Inverted Luminous Arc Lamps.

(b) Mount lamp from twenty-five to forty feet above street level to assist distribution and prevent blinding from glare.

Where the character of lighting will permit the use of diffusing globes, the effective illumination will be increased.

(c) Select unit giving white light, as the eye is more sensitive to the short waves.

II.

The statements under I apply to outlying districts, except where economy necessitates the use of smaller units represented by 4 amp. magnetite unit or a combination of magnetite and series incandescent. The proper mounting height, of course, will depend on the unit employed.

III.

(a) The requirements of small cities and towns are almost parallel to the requirements of the streets of lesser importance and outlying districts in the larger cities. The same care in placing lamps should be observed.

IV.

Ornamental or display lighting permits of real treatment by the illuminating engineer, and its success, to a greater extent than any other class, is measured by effect and impression. Though we had daylight intensity uniformly distributed on the streets by means that are harsh and present sharp contrasts between the street and the buildings, the system is not a success. Display lighting carries with it the idea of favorable and pleasing impression. To accomplish this the units must be mounted on ornamental standards in keeping with the surroundings, and the light must be diffused in a manner pleasing to the eye. In order to prevent a sharp line of light at the level of the unit and bring out the architecture of the buildings,

thereby giving the desired impression of good illumination, a large part of the light should be directed above the unit level by suitable globe design. It is an interesting fact that diffusing globes, properly applied, though reducing total light flux projected from the lamp, will increase the effective illumination.

For the best results practice indicates that ornamental units should not be spaced closer than 100 feet, and the best results are obtained by mounting units 12 to 15 ft. above street level.

A single large unit per pole is more effective than a group of small units. It lends grandeur to the lighting scheme and can be operated and maintained more economically.

V.

In the average park we are confronted with obstructions in the way of trees and shrubbery which prevent proper distribution from large units. Again, the field does not demand high intensity. Therefore, the series Mazda lamp, mounted on suitable posts, with diffusing globe, gives a very satisfactory unit. Our principal cities are adopting the single unit standard.

Type of Lamp Standard at Sacramento, California

Illumination of State Capitol at Sacramento With Pendant Type Arc Lamp.

VI.

Parkway Lighting.—The problem presented here is the economical illumination of extensive roadways with heavy automobile traffic. Experiments with low intensity, approaching uniform distribution, utilizing small units closely spaced, vs. high maximum, with low minimum intensities, utilizing large units spaced from 250 to 300 feet, indicate that the latter is more effective.

The small units of relatively high intrinsic brilliancy, placed at a lower height, are found to be detrimental to drivers of automobiles. In case of the parkway lamp (large unit), placed 250 to 300 feet apart, vehicles in the road are seen by silhouette against the splash of light in the distance. This enables drivers to judge distance more correctly without apparent effort. At first an approaching machine will be clearly discerned in the vicinity of the lamp; passing this point, the silhouette of the machine against the light enables drivers to correctly judge position of approaching vehicles.

In the case of low uniform intensity, the approaching machine is blurred and without shadow reliefs, which are necessary for determining distance.

The parkway lamp is the 4-ampere Magnetite, with specially designed globe and reflector, and should be mounted 18 ft. above roadway.

DISCUSSION.

P. T. Hanscom, Chairman: The meeting is now open for discussion. Mr. Armadoux, can you give us some ideas on this subject?

Mr. Armadoux: I would like to know why it is that there is more value obtained in illumination by keeping the units down so low, rather than by using a lamp on a higher pole. In other words, why not set it up higher, and get the effect by placing the lamps more out of the line of vision, thus tending to diffuse the light. It would seem to me that if you do set the lamp up higher, and keep it more out of the line of vision, you would be able to get the same ornamental effect as by putting it down lower, and diffusing the light so that it is cast above the plane of the horizontal. I would like to hear what Mr. Wallis has to say about that.

C. R. Wallis: The efficient units have a high intrinsic brilliancy. It is practically impossible to place units at a height that you can entirely overcome glare without some means of diffusion. You are limited by the cost of poles, and you are also limited in a way by the esthetic effect of tall poles on the street. Again, you have the physiological effect of different intensities, as I pointed out. You may get a higher illumination on the street as measured by a photometer by placing the units higher, without diffusing the globes, but the "effective illumination" would probably not be nearly as good by reason that it is almost impossible to get them high enough to keep the intense ray, which comes from this point of light in the high efficiency unit, from striking the eye, which will cause the pupil of the eye to contract. Therefore, you do not get as much light reflected, from the object which you are illuminating, to the eye. That is where you lose. Does that answer your question?

Mr. Armadoux: I don't know that it does altogether, because it would seem to me that, no matter how you diffused the light, when you keep it down at a height of say 18 or 20 ft. or so, looking down the street, the first lamp in the line of vision you are bound to get a glare effect from it, no matter if you do use a diffusing globe, while if you set that up higher and get more the benefit of the light, you will keep away from the glare.

C. R. Wallis: The lamps in this case have the light sufficiently diffused, so, as a matter of fact, you don't get the glare. The idea of glare would be the intense ray of light projected direct or reflected to the eye from a lamp which has a high brilliancy, which will result, unless the lamp is mounted extremely high.

Mr. Armadoux: At the same time you get that diffusion on the low lamp.

C. R. Wallis: We are working there for effect, not entirely for illumination. If we get a better effect, as has been generally found, by diffusing the light, we have gained a point. In ornamental Mazda installations, you do not think of using the lamp bare without a diffusing globe. In the first place, you don't get the lighting effect. In order to make the system ornamental you cannot have your light projected from a point. You must have it projected from a large surface; and that is the reason that the ornamental lamps and ornamental light employ diffusing globes. I think that can be better understood by observation than by any attempt at explaining. It is a question of psychological effect. From the early days of street lighting—there are some relics in the country where they started in with the high brilliancy open arcs placed at

low height, which led to the idea that street lighting could be better accomplished from towers, in which the lamps were placed very high. In some American cities, such as Detroit (Stockton has some of those towers) they placed the lamps at extreme height above the street. Of course, in doing that and in grouping the lamps, they are lighting a large area; in some cases they are lighting housetops, which is not desired, and, of course, with units of the efficiency we had then, or today, this is out of the question from the standpoint of cost. Tower lighting could be used well for exposition work, where areas are lighted instead of length of street. There is no reason why lamps should not be mounted at great heights except the cost, loss of efficiency, and appearance.

Mr. Armadoux: I wasn't expecting to go to extreme height, but whether a difference of a few feet in height would not give the same effect at less cost than keeping them down so low, and diffusing.

C. R. Wallis: We showed in one slide extremely tall experimental poles at Rochester, N. Y. That is an example along your line, and they found out that using the lamp with a diffusing globe on a lower pole gave a better effect.

Mr. Armadoux: I guess that is something that the eye can see better than anything else.

C. R. Wallis: Exactly.

A. J. Bowie: Mr. Wallis has brought out the fact that the effect of lighting is not merely physical, but is also physiological—which means, of course, that we cannot always reduce it to a mathematical equation. The effect of different colors in lighting is a matter which, it seems to me, is of a good deal of importance. Possibly the personal equation enters a good deal into the case; but I will say that it always seemed to me that Market street (San Francisco) was a great deal lighter when either the arcs or the incandescents were out—when they were not both going at the same time; that the color scheme of the two systems of lighting did not blend at all; and I would like to ask Mr. Wallis if the effect of mixing colors has received much recognition from illuminating engineers? If it has, it would seem to me that it would be unadvisable to combine generally the light of white arcs with the lighting of incandescents, such as happens in downtown districts. In other words, in such districts it would be better, if you used arcs at all, to us the flaming arc of yellow color.

C. R. Wallis: That question has received consideration by various engineers, and experiments have been made in putting in different installations, where they could not get the proper effect with one unit. In Atlantic City they made some experiments there in lighting the board walk. They wanted to get light on the board walk so that people could recognize each other. They also wanted a well-distributed light over the whole area. Mazda lamps in clusters were placed about twelve feet from the ground, and on top of the pole, which was twenty or twenty-five feet. They tried different styles of arcs to find out which type would give the better effect. They tried the magnetite and enclosed carbon. (I don't know whether they tried the flame or not), but found that the contrast between the Mazda lamp and the magnetite was such that the general effect was undesirable, so they finally adopted the enclosed carbon arc for that purpose. The light of the enclosed carbon arc and the Mazda lamp seemed to blend much better.

Another example of this is in Washington, D. C. I have seen some unfavorable comments from using the magnetite lamp and the Mazda lamp in combination for street lighting. The effect is not at all good. Most illuminating engineers have considered the subject in one way or another, and they have dealt with the color scheme. It has been pointed out that color has advantages or disadvantages in various classes of street lighting. For low intensity, white light gives the best results, because the eye is more sensitive to white. Where you have a high intensity for display lighting the effect of the yellow light is good. It brings out the detail better than the white, but, on the other hand, yellow is more distinctive to sign lighting.

A. J. Bowie: I understand from that that it would be the general tendency of practice of the companies manufacturing lamps to recommend in the downtown districts not the magnetite lamp, but the flaming arc, or don't they recommend the flaming arc because they mix in with the sign lighting and effect illumination of the windows?

C. R. Wallis: The manufacturers have not taken any stand on that point at all, as far as recommendation of the two lamps goes. There are various commercial considerations which would determine the use of the lamp. As a matter of fact, although a yellow light may bring out detail of the buildings better than a white light, I think for general ornamental lighting that the white light given by the magnetite lamp is more effective. I have noticed in installations that have been made that the contrast between the white light diffused from an Alba globe and sign lighting in that class of work, is effective. Looking down the street where you have a number of signs, there is a contrast there which gives a pleasing effect.

A. J. Bowie: You don't think the yellow light is superior necessarily where it has to mix with the sign lighting?

C. R. Wallis: Personally I do not think so. I believe that the contrast between the sign lighting and your display lighting is desirable. It certainly makes your signs more effective.

A. J. Bowie: It may make the signs effective, but does it make the street more attractive?

C. R. Wallis: I think so.

Henry Bosch: I should like to ask Mr. Wallis with reference to the pendant type of lamp for street illumination, what is the recommendation of the spacing of lights?

C. R. Wallis. A 4-ampere magnetite is generally mounted from eighteen to twenty-five feet.

Henry Bosch: Do you find that is really the most desirable height?

C. R. Wallis: We find that twenty-five feet to thirty-five feet is the most desirable height for lamps spaced 350 to 400 feet apart (which is the average block)—a lamp thirty-five feet above the ground, the maximum ray 10 degrees below the horizontal, will strike the ground about midway.

Henry Bosch: I had in mind the spacing of your large units and the smaller ones shown in your exhibit.

C. R. Wallis: I intended to represent by the smaller lamp the placing of small units, as would ordinarily be carried out for giving a low uniform intensity.

Henry Bosch: That is a characteristic of park lighting?

C. R. Wallis: That particular case was intended to represent parkway lighting. Of course, you understand, that would be a small scale.

Henry Bosch: I catch the point, but you show it is more favorable to use a unit of higher intensity than to use numerous smaller units.

C. R. Wallis: Exactly. If you are going to produce low uniform intensity, you necessarily must use a smaller unit, and all we have available for that is either the incandescent units or gas units.

C. R. Wallis: Experimentally. Fourteen feet six inches is not intended for height of parkway lamp. This should be mounted 18 feet above roadway.

Henry Bosch: Is there any objection to the pendant type of lamp for park illumination?

C. R. Wallis: There is no objection other than from the standpoint of ornamentation and size of unit. In the parkway lamp a reflector is used above the lamp, and practically all the light is delivered in the lower hemisphere; a diffusing globe is also employed to prevent any glare.

R. B. Hussey: I might say one thing in regard to the

color of street lights. A good example of the difference between the white light and the yellow, in comparing Federal street, in Allegheny, and Broad and Market streets, in Newark, N. J., I think the result is largely a matter of personal opinion as to which one you will consider the best. The lighting in Allegheny is with white flame arcs, and in Newark with yellow flame arcs. Now Newark is supposted to be lighted about as intensely as any city there is; that is, that particular part of Newark, and it is so intense that it detracts very largely from the sign lighting—so much so that the signs are practically inconspicuous; and it also detracts from window lighting. That is a point which is of great importance, I think, in connection with power companies. It depends largely on local conditions as to whether it is best to light the street at high intensity and lose the window lighting or light the street perhaps to a somewhat lower intensity and have good window lighting; and that also applies to sign lighting. Take Broadway, New York, for instance, the regular street lighting is entirely lost; it is inconspicuous. The White Way is entirely from the signs that are placed so conspicuously along Broadway, and that makes its name. You go over to Fifth avenue, and your lighting there is entirely from regular street lighting. If I remember correctly, they have six lamps to a block, and they are so arranged that there are four lamps at the street intersections and two lamps midway in the block, on the opposite side of the street.

There is a point in connection with that which I do not think has been touched on tonight at all, and that is this: With an effect perhaps similar to that which we have on this illuminated plat here, the lighting down the street is uniform throughout the length of the street, and it is difficult to distinguish street crossings. The lighting in Ontario, Canada, is entirely with tungsten lamps, and they installed lamps throughout the street to give a somewhat similar effect to this, and it was found there they had some difficulty at first at the crossings, due to the fact that the lighting there was of the same intensity as in other parts of the street, and it was difficult for approaching vehicles to be distinguished, or rather to distinguish the crossing, which, of course, is the point of maximum travel in the street.

There is another point in regard to the relative merits of uniform and nonuniform background to get your silhouette effect. If I understand Mr. Wallis correctly, the idea that he has is that lamps placed, say, 400 feet apart, or 350—whatever your average street length may be—in giving a fairly high intensity immediately under the lamp at the street crossing, makes a bright point against which you object or machine is seen in silhouette. Now, on some of the slides that were shown you get a uniform background and fairly high intensity; and it seems to me that your silhouette effect would be as great or greater with a background of that kind than it would be with the lamps spaced so far apart. That, of course, is a point which is rather difficult to demonstrate one way or the other, I think. It is rather difficult to demonstrate it in actual trial; and it is difficult to demonstrate it by an actual installation. But I think the effect would be perhaps better with the more uniform lighting.

There is one other point in regard to the height of the poles. There was some discussion about 14½ feet. When you place a lamp at that height with the distribution characteristics as given, you get, as you notice here, a rather intense light immediately under your lamp; and in the center of the street the lighting is not as great; and there is considerable difference between the maximum and the minimum intensity along the street. Now it seems to me that if those lamps were placed at nearly double the height, you would get a good deal more uniform illumination, and it would probably be less difficult to traverse the street. That is, the eye, as you would travel along the street, would not have to change from a condition of fairly or very high illumination to one of lower illumination, which change is rather fatiguing. If the lamps were placed further apart and higher, I think the effect would be better. The wattage, of course, per foot of street would be less, but I think the result in the end would be more pleasing, and the street would be more easily traversed.

C. R. Wallis: In connection with the remarks of Mr. Hussey, I want to say that this scheme in practice partly utilizes the ideas which he has expressed. In the exhibit we are considering an example of roadway lighting, and in that case your lamps are placed a good deal higher than is shown. You have a certain amount of money with which you can maintain a system. Instead of putting that money into a low uniform system, a system that will give you a low uniform light, experiments indicate that much better results can be obtained by using large units placed on the poles as indicated, some 300 feet apart. These statements do not apply literally to display lighting, as indicated by reference made to the slides. In this case we have a relatively high intensity. The objection to placing poles close in ornamental display lighting is at least two-fold. If we use a low intensity with the smaller unit, we will have a regular forest of poles on the street; whereas, by spacing the units further and having a reasonable maximum and minimum, the general results, I believe, are better. In each case we have the commercial side to consider. By spacing the units further, and using a larger unit, we may keep up the minimum and have a higher maximum, which gives us the shadow of relief.

Mr. Hussey: I think it depends very largely upon whether you are discussing high intensity or medium intensity installation; that is, high intensity comparatively, such as you have in a city district, or low intensity comparatively, such as you use in an outlying district.

Now with the city district, where the intensity is high, there isn't as great a necessity for uniformity of intensity as there is where the light is of lower average intensity; that is, if you are working where your lamps are 400 feet apart, you are working at a point where you are slowly traveling from low to high intensity, which, at the low intensities you are using, is very fatiguing to the eye.

C. J. Wilson: One point as to the placing of the lamps, particularly in outlying districts. I think if we consider the photograph as illustrating the effect of light and shadow on the eye, and compare the photograph which has low contrast with one which has very much contrasted shadows and high lights, the photograph having no shadows in it is not usually considered artistic or pleasing to te eye, while a photograph having considerable shadow effect is much more effective and more pleasing.

In the same way the distribution of light in an outlying district, especially driving at night, I don't agree with the gentleman who states that it is fatiguing to the eye. I think the effect is not at all fatiguing, and at the same time objects appear more in contrast by passing from a high light to a fainter light; and I think it is much easier to travel with that type of lighting along the street. Now the units to be used to obtain that effect, the magnetite unit, I think, has an effective ray 10 degrees below the horizontal about 2.23 candle power per watt, if I understood Mr. Wallis correctly, while the less intense units, such as the tungsten or magnetite light, have effective candle power of only about one candle power per watt. The spacing of the lamps with the higher intensity of ray 10 degrees below the horizontal can be considerably greater with the same consumption of current. For that reason I think you get the advantage of more light for the amount of current used and more effective illumination. Of course, for what might be termed ornamental lighting, electrolier lighting and such lighting as that, the smaller united spaced closer seem to be more effective, particularly in downtown districts, where there has seemed to be a demand for more intense illumination on the street.

READINESS TO SERVE METHODS

METHODS OF APPROACH.

BY ROSS B. MATEER.

Much has been written on commercial policies and the utopian principles underlying the efficient and progressive business-getting organization.

Rules have been made, and frequent rehearsals on the part of the soliciting staff, which would, it seems, result in an army of aggressive and efficient salesmen, interested in promoting the sales of "juice." Book knowledge, it seems, is provided in large quantities, but is similar to the theory advocated by the scientist, and seldom brings practical results. Practice, not theory, is what is needed to-day in developing agricultural sales. A generous response by the central stations to the appeals for modern conveniences consist in granting liberal extensions of line and in maintaining an aggressive agricultural sales department, not in turning a deaf ear, and assuming a general attitude of "go to blazes."

An extensive campaign for developing current sales by the use of appliances may be characteristic of the companies in some cities, but in the great majority the elaborate display of bright, current-consuming utensils and motors remain within plate glass cases, and even the urban resident approaches the sacred cabinet with trepidation. Admitting that such a spirit is to be found in the city, can a quasi public utility expect the farmer, who is the producer of riches, to view motor-operated and current-consuming apparatus with the awe of the urban resident when appreciative of the apparatus for its value as shown by an increase in productiveness? Will the lighting company's approach to the customer be such as will invite and receive his confidence, commanding his respect and encouraging in him a spirit of co-operation?

Methods of approaching prospective consumers are many, and yet no two are identical in that they have resulted in revenue for the utility and increased production to the farmer.

Few, if any, agriculturists are of a technical mind and all references to technical phrases should be omitted when discussing a proposed installation.

Do not dally on the voltage or general mechanical advantages of the apparatus, nor be content in quoting the price per kilowatt. The vital part of your argument is what the farmer must pay for his "juice," that he may produce a more prolific tree or vegetable, and what percentage of his probable returns from the crop does his power bill represent.

Should actual figures be necessary, it is worth while to have them accurate and permit a close check between the estimated bill and that rendered per annum.

Be a judge of "human nature," learn to act quickly, distinguishing, if you please, between the conservative and the "never-to-be-interested" prospects. Some may admit all your arguments, but delay a decision, while a few may leap before giving the proposition mature consideration. Come back another day where your presence is desired only for companionship. Rather devote your time to those of the progressive and conservative type, who believe when actual profit is in evidence.

Do you ride a "hobby"? Many do, and its path frequently leads to the actual contract. A general knowledge of current events is not without value where the man with a "hobby" is at issue.

Perfection is to-day found in no man, neither is all knowledge bound in one frail human casing. When discussing a point at issue and you are not quite sure, it is better to ask a few questions which may shed additional light, permitting of an answer at par. Then your knowledge will be properly rated in the mind of the farmer, and unaffected by the "bull or the bear."

Be prepared to quote on installations of a similar character, bearing in mind some average statement as to cost.

In closing, it is suggested that the sales engineer approach his prospective consumer upon a friendly basis, encouraging the friendship of his prospect. Be interested in what is of moment to him. Aim to provide such installations as are the best from the standpoint of economy and service to the consumer. Pave the way for additional current consumption by aiming at the mark and with accuracy, maintain the parity of your stock. Aim to build up such an output of current in the rural districts that what is sometimes considered the tail of the public utility will ultimately wag the entire organization.

Experimental, pioneer, co-operative, or whatever term be applied to the development of current for farming purposes, it is not too much to predict that as the industrial business superseded that of the illuminating from a revenue-producing standpoint, so will the agriculturist rank first from that of load factor.

Talk to the farmer in his language, the increase yield per acre through a generous supply of water and the cost of such water per season. He knows his yield in sacks of beans per acre, or hundred-pound sacks of potatoes. He speaks in tons of alfalfa per acre, not in the rate per kilowatt.

He knows the water is necessary; how can it be delivered at a minimum of cost and what is the expense per acre foot?

PRESUMPTION FROM FAILURE TO CALL WITNESS.

In the Patent Office proceedings of Steinberger vs. Hewlett the following interesting ruling was brought out August 6, 1912:

Where in a case involving the question of originality an inventor fails to take the stand who is available as a witness when the facts in his favor, if any there be, the peculiarly within his knowledge, the legal presumption follows that his testimony would be unfavorable to his case.

INVESTIGATION OF TRANSMISSION LINE PHENOMENA.[1]

BY E. H. LE TOURNEAU AND E. D. SEARING.

The series of tests represented by the oscillograms shown in this paper were inaugurated primarily in an attempt to discover and assign causes for failures of suspension type insulators on the steel tower transmission line of the Portland Railway, Light & Power Company, and also for various phenomena occurring at time of switching operations.

The steel tower transmission line has been described in a previous paper before this section of the American Institute of Electrical Engineers.[2] The line is 27.6 miles long, the conductor being 250,000 c.m. hard drawn copper strand, supported on suspension insulators in a vertical plane on one side of double circuit steel towers. At the present time approximately nine miles of the line is of temporary construction and is composed of No. 0 copper strand supported on 60,000 volt insulators on wooden poles and crossarms in a horizontal plane. There are at the present time no tap connections made to the line although the line was operated for several months with a tapped connection near the Portland and which extended to Beaverton, Oregon. There are no transpositions in the line. The line operates at 60 cycles and approximately 60,000 volts with neutral grounded and is protected at both ends with aluminum cell lightning arresters.

There were obtained a total of 175 oscillogram records, nearly all of which were taken during the night or on Sundays on account of operating conditions. For convenience in comparing results, the tests have been grouped as follows:

A. Switching off and on the line by high tension oil switches.

B. Switching transformers off and on to line by high tension oil switches.

C. Switching off and on line and transformers by high tention oil switches.

D. Switches off and on line and transformers by low tension oil switches.

E. Switching transformers on to operating system by closing low tension oil switch.

F. Opening line with high tension oil switch when carrying load.

G. Effect of switching on line when fused to ground.

H. Effect of charging lightning arresters.

I. Voltage, induced by parallel lines.

J. Switching off and on line with connected load by high tension oil switches.

K. Switching 11,000 volt lines.

L. Effect of synchronizing.

M. Open circuit wave forms and normal operating conditions.

N. Telephone line tests.

O. Switching off and on open line by air break switch.

P. Opening line with air break switch when carrying load.

Q. Time of closing switch contacts.

As will be noted from the preceding tabulation, the tests originally outlined led to a number of secondary investigations, interesting in themselves as considered separately from the main subject. The results which can be derived from a comparison of the records will be tabulated under the headings given above and typical oscillograms shown.

[1]Paper presented before Portland Section, A. I. E. E.
[2]See April 6, 1912, Journal of Electricity, Power and Gas.

A. Switching off and on open line by high tension oil switches.

The high tension oil switches at the River Mill generating station for connecting the line and transformers to the station bus are of the steel tank type manufactured by the General Electric Company and known as the Form K-10 switch. The switches for use on the 11,000 volt circuits, which is the voltage of generation, are known as Form K-12. The high tension switches as well as the 11,000 volt switches at Lincoln substation are also of General Electric make and are known as Form H-3.

The time required to completely disconnect the line with the Form H-3 oil switch, as indicated by the disturbance caused in the current and voltage wave forms is approximately 2 cycles, while that required by the Form K-10 switch is 5½ to 6 cycles. In the same way, time required for conditions to become normal upon closing the circuit with Form H-3 oil switch is approximately 1 cycle while the time required with a Form K-10 switch is 2 to 2½ cycles. The rise in voltage, varies in the different records, due largely to the point of the voltage cycle at which the switching operation commences and to the length of time required to complete the operation. In the case of switching off the line with the Form K-10 switch, the instantaneous maximum of voltage on the line during switching exceeded the instantaneous maximum of the normal wave by an average of 43 per cent representing observations made on the end of the line at which the switching took place and by an average of 68 per cent representing observations made on the opposite end of the line. When switching off the same line with Form H-3 switch, the instantaneous maximum of voltage on the line during switching exceeded the instantaneous maximum of the normal wave by an average of 23 per cent, representing observations made at the end of the line at which the switching took place and by an average of 40 per cent, representing observations made at the opposite end of the line. In the same way when switching on the same line with the Form K-10 switch, the rise above normal was 30 per cent at the same end and 65 per cent at the opposite end of the line and with the Form H-3 switch the rise above normal was 12 per cent at the same end and 17 per cent at the opposite end of the line.

These test records indicate that the Form K-10 switch causes a greater disturbance on the line than the H-3 switch, and in either case the disturbance is greater at the end of the line remote from than at which the switching is done.

In addition to the effect upon the voltage conditions of the line itself caused by switching on and off the steel tower transmission line, there is a decided effect upon the voltage conditions of the station or system to which it has been, or will be connected, in some cases exceeding the voltage rise on the transmission line itself.

In one instance the line was switched off from the River Mill generating station and the voltage rise was sufficient to jump across the terminals of a 57,000 volt potential transformer connected to the bus, a distance of 10½ in.; this short-circuit caused the generator switch to open automatically. The rise in voltage as shown on the oscillogram was approximately

58 per cent, or an instantaneous value of approximately 137,000 volts.

Also the effect upon the entire 60 cycle system was very marked when the tower line was switched off or on. A convenient method of observing this was obtained at the River Mill Station where a tap from the Cazadero line enters. A voltage rise as high as 39 per cent was observed at this point when the tower line was switched off at the Portland end at Lincoln Substation, requiring that the disturbance be transmitted through two banks of transformers, and the 11,000 volt cables and overhead lines in Portland.

In order that the measurements of voltage on line might represent actual line voltages, the choke coils were short circuited at River Mill, placing the potential transformer connections directly on the line. This arrangement was not necessary at the Lincoln Substation end of the line, since the temporary connections to potential transformers were made outside of the choke coils.

In a number of instances, the aluminum electrolytic lightning arresters operated and this, no doubt, prevented the voltage from reaching even higher values than those shown on the record curves.

Some question was raised with reference to the use of potential transformers for measuring high frequency surges of voltage, and it was thought that there might possibly exist even higher frequency surges than those shown on the records obtained, and that these high frequency variations would be damped out by the potential transformer iron. In order that this might be investigated, a non-inductive resistance was constructed by using approximately 12,000 ft. of No. 28 B. & S. gage "Climax" resistance wire. This wire was mounted on wooden frames, suspended from insulators and a current of approximately 9/10 of an ampere was allowed to flow from the line to ground through this 400,000 ohm resistance. One vibrator of the oscillograph was shunted across a small portion of this resistance and one vibrator of the oscillograph connected to a potential transformer on the same phase with the non-inductive resistance. The curves obtained with these two vibrators were almost identical and not only proved that the potential transformer was satisfactory in recording voltage variations up to the limit of frequency, which could be recorded with the oscillograph, but also showed in a remarkable way the reliability of the oscillograph in duplicating the very high frequency surges obtained.

B. Switching transformers off and on to line by high tension oil switches.

In these tests the three 3667 k.v.a. 3-phase transformers were simultaneously thrown off and onto the transmission line by opening and closing high tension line oil switch, the low tension side of transformers being open. Here again the use of the Form K-10 switch causes slightly more disturbance than the use of the Form H-3 switch but the disturbance is greater at the end of the line at which the switching is done.

The rush of current upon closing the circuit to the transformers is very clearly shown in the records obtained, reaching an instantaneous peak of over 100 amperes of current taken from the line. These instantaneous surges of current decrease with each cycle, always occurring on only one side of the zero line, until in about 20 or 25 cycles a uniform wave is obtained in which the harmonics are nearly of equal magnitude with the fundamental. Also the curve shows plainly how the current changes from approximately 90 degrees leading to approximately 90 degrees lagging by the omission of one-half of a cycle. The explanation of the swings of current on only one side of the zero line would seem to be that the residual magnetic flux exists in one direction and it requires approximately one-third of a second to restore complete reversal of magnetic flux.

Similar tests were also made on the transmission line from the Cazadero power station to the Knott substation in Portland. This line is of wooden pole construction entirely and has two taps taken from it feeding Lents and Tabor substations respectively. The switching on and off of transformers on this line, designated as No. 57602, has practically no effect upon the voltage, simply causing a slight variation in wave form. The neutral current shown in these records is an almost pure third harmonic when line only is connected but has also a fundamental component when line and transformers are connected.

C. Switching off and on line and transformers by High Tension oil switches.

In the records shown as representing these tests, three 3667 k.v.a. 3-phase transformers were connected on the high tension side to the line with the low tension side open and the high tension oil switch on the opposite end of the line opened and closed. In these tests again the Form K-10 switch causes the greater disturbance and the voltage rise is greater at the end of the line opposite to that at which the switching is done, i.e., the greater disturbance occurs at the point between line and transformers as would be expected.

In one of the records shown the arc across the switch terminals was re-established after the line voltage had become practically zero and in one case high frequency surges were set up between line and transformers, of the order of the seventh harmonic which is the principal harmonic existing in the normal voltage wave.

D. Switching off and on line and transformers by low tension oil switches.

These tests were performed by opening and closing the 11,000 volt oil switch on the low tension side of transformer, the high tension side of which was already connected to the open transmission line. In some of the tests the high tension sides of two other transformers were also connected to the line, the low tension side being open. The records obtained while switching off show very little disturbance, the voltage gradually dying out in two or three reversals occupying more time than a fundamental cycle. In switching on, however the phenomena became more complex. In one record after two complete cycles of apparently normal conditions a series of surges is set up in the entire system and a peak of 41 per cent above the instantaneous maximum of normal wave is obtained on the tap from the Cazadero line which enters the River Mill Station. Record No. 251 seems to mark a very pronounced series of surges after eight complete cycles

have elapsed from the indicated closing of the switch. A satisfactory explanation of the voltage record shown on the film has not been obtained. Possibility of faulty contacts in the oil switch led to the series of tests under heading "Q." The test was repeated a number of times, but a like result was not obtained. A very interesting record was obtained, in which the instantaneous value of current on one side of zero line reaches approximately seven times its previous maximum, and after the completion of two cycles the magnetization of the iron seems to completely reverse itself so that the higher peak value of current occurs on the opposite side of zero line. A noticeable feature is the very high frequency of the current at the instant of switching.

E. Switching transformers on to operating system by closing low tension oil switch.

This test was made to ascertain if the drop in voltage which occurs on system when these transformers are switched on was accompanied by marked surges of voltage. This does not seem to be the case, and the drop in voltage seems simply to be due to first rush of current into transformers.

F. Opening line with high tension oil switch when carrying load.

These tests were made by opening the Form K-10 oil switch on line at River Mill Station when line was carrying regular system load, the load being transferred to othe stations. The load was dropped with no disturbance whatever, as the records show. An interesting point is the increase of line current at the instant of opening.

G. Effect of switching on line when fused to ground.

In order to perform this test a piece of No. 30 B. & S. gage copper wire about 20 ft. long was connected between the lower leg of line and ground near Lincoln substation. The high tension oil switch was closed, energizing the line in this condition from a generator at the River Mill Station. In one record the line was energized from turbo-generator at Station "L." The peak value of potential on the turbo-generator was 72 per cent above the instantaneous maximum of the normal wave. In Record No. 252 the fuse instantly burned off and the generator oil switch did not open automatically as in other cases. The upper leg of line reached a maximum potential to ground of 89 per cent above instantaneous maximum of normal wave. Pictures were taken of the flash when the wire fused.

H. Effect of charging lightning arresters.

Although the charging of lightning arresters appears to have practically no effect upon the voltage wave of the line, a very interesting series of records were obtained. In Record No. 141 the effect of charging lightning arresters upon the current in transformer neutral is recorded. The normal transformers neutral current is found to exist of a 33-cycle fundamental. Also, the wave shape appears to nearly duplicate itself every fifth cycle, which is explained by the relation of time required for five 33-cycle waves being approximately equal to the time required for nine 60-cycle waves. The existence of a 33-cycle wave in the neutral of the 60-cycle transformers is explained by the arrangement of the 33-cycle transmission lines paralleling the 60-cycle lines. In the part of the steel tower line, which is temporarily supported on wooden pole construction, the 33 and 60-cycle lines are on the same poles, the 33-cycle line occupying the top position and being arranged in an equilateral triangle, and the 60-cycle line is a horizontal plane, with two conductors 34 in. apart on one side of pole, and the third conductor 68 in. from nearest conductor on the opposite side of the pole. The 33-cycle neutral current is evidently the result of unbalanced induction from the 33-cycle line paralleling the 60-cycle line. In Record No. 141 the 60-cycle line is open at one end, and the effect of the 60-cycle current is not very marked, while in other record taken the 60-cycle line is carrying load, and the 60-cycle current, representing slight unbalance, predominates; another record shows the current in one tank of the lightning arrester as well as in the ground connection from all three tanks while the arrester is being charged. The ground current shows the third harmonic as would be expected while the eleventh harmonic predominates in the charging current for one tank only. The effect of charging lightning arresters upon telephone lines was investigated. The normal wave induced in the telephone line is a combination of 33-cycle and 60-cycle voltage with the high harmonic greatly increased by charging arresters.

I. Voltage induced by parallel lines.

This test was made by connecting the oscillograph to potential transformer on tower line, which was open at both ends. The 60-cycle wave was taken from the station bus for purposes of comparison.

The remarks concerning transformer neutral current apply to the induced voltage waves. The waves repeat themselves every fifth cycle. The 33-cycle wave predominates, on account of the proximity of the 33-cycle line to the line in which the voltage was induced. The other 33-cycle line and 60-cycle line have their effect, however.

J. Switching off and on line with connected load by high tension oil switches.

There are two substations tapped on to the Cazadero line, and hence the switching on and off of this line represented the switching of a loaded line. The disturbance was not very marked in either case, except in the case of the neutral current shown on Record 210. The gradual reduction in voltage and frequency shown on Record 209 is undoubtedly due to the presence of rotating machinery on the line.

K. Switching 11,000-volt line.

This field of investigation was hardly touched upon. No effect of switching cables was discernible in wave form of high tension transmission line voltage.

L. Effect of synchronizing.

One record shows a slight surging of current in the line after synchronizing. The actual instant of closing the switch is not shown.

N. Telephone line tests.

Some of these tests have already been referred to and the effect of charging lightning arresters upon telephone lines noted. Record No. 216 was taken as the voltage wave form induced in the telephone line,

Line energized from 60-Cycle System at Lincoln Substation.

Observations made at Station "M."

Note: During this test Transformers Nos. 1, 2 and 3 were connected to 11,000-volt bus and 57,000-volt bus at Lincoln Substation, neutral of No. 3 transformer grounded. Line No. 57605 was open at Station "M" and energized from Station "G" through Line No. 57602 which was carrying 60-cycle system load.

Curve 1—I = Current in ground connection from lightning arrester tanks. No discharge.

Curve 2—E = Potential between middle leg of Line No. 57605 and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 39% above instantaneous maximum of normal wave, approx. 68,000 volts. Normal = 34,500 volts effective, taken from switchboard reading.

Curve 3—E = Potential between middle leg of Line No. 57604 and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 22% above instantaneous maximum of normal wave, approx. 57,000 volts Normal = 33,000 volts effective, taken from switchboard reading.

Line energized from 60-Cycle System at Lincoln Substation.

Observations made at Lincoln Substation.

Note: During this test transformer No. 3 was used at Lincoln Substation, neutral grounded.

Curve 1—I = High tension line current, 30:1 ratio current transformer. Peak value of line current = 36 amperes approx.

Curve 2—E = Potential between lower leg of line and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 34% above instantaneous maximum of normal wave.

Line energized from 60-Cycle System at Lincoln Substation.

Observations made at Station "M."

Note: During this test transformer No. 3 was used at Lincoln Substation, neutral grounded. Line No. 57605 was open at Station "M" and energized from Station "G," through Line No. 57602, which was carrying 60 cycle system load.

Curve 1—E = 57,000-volt station bus potential, 500:1 ratio potential transformer. No rise of bus potential.

Curve 2—E = Potential between middle leg of Line No. 57604 and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 9% above instantaneous maximum of normal wave.

Curve 3—E = Potential between middle leg of Line 57605 and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 17% above instantaneous maximum of normal wave.

Line energized by Generator No. 2 at Station "M."

Observations made at Station "M."

Note: During this test transformers Nos. 1, 2 and 3 were connected to 57,000-volt bus at Station "M." 11,000-volt switches open on Transformers Nos. 1 and 3. Transformer No. 2 connected to No. 2 generator. Transformers Nos. 1, 2 and 3 were connected to line No. 57604 at Lincoln Substation. 11,000-volt switches open. Neutrals of all transformers grounded. Form K-10 oil switch was opened between transformer No. 2 and high tension bus.

Curve 1—I = High tension line current, 30:1 ratio current transformer. Peak value of line current = 9 amperes approx.

Curve 2—E = 57,000-volt sta. bus potential, 500:1 ratio, potential transformer. Peak value of bus potential = 29% above instantaneous maximum of normal wave.

Curve 3—E = Potential between middle leg of line and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 29% above instantaneous maximum of normal wave.

Line energized from 60-Cycle System at Lincoln Substation.

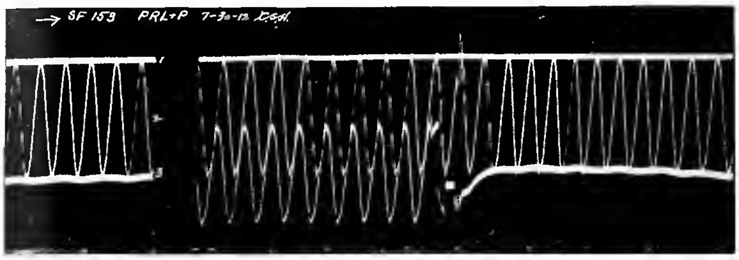
Observations made at Lincoln Substation.

Note: During this test transformers Nos. 1, 2 and 3 were connected to 57,000-volt bus at Lincoln Substation, neutral of transformer No. 3 grounded. Resistance used for curve No. 1 was approx. 12,000 feet of No. 28 B. & S. gauge Climax resistance wire supported on wooden frames.

Curve 1—E = Potential between lower leg of line and ground, measured by taking drop across shunt in series with approx. 40,000 ohm non-inductive resistance (see note). Peak value of potential to ground = 42% above instantaneous maximum of normal wave.

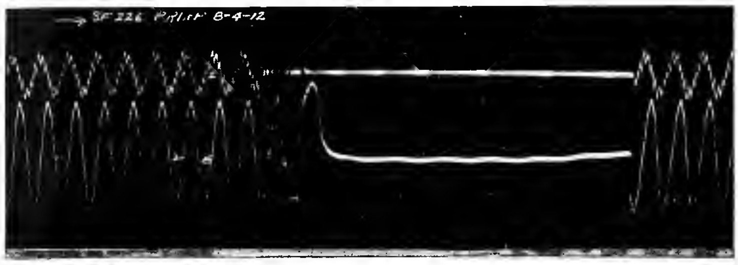
Curve 2—E = Potential between lower leg of line and ground 300:1 ratio potential transformer. Peak value of potential to ground = 54% above instantaneous maximum of normal wave.

Curve 3—E = Potential between middle leg of line and ground 300:1 ratio potential transformer. Peak value of potential to ground = 40% above instantaneous maximum of normal wave.



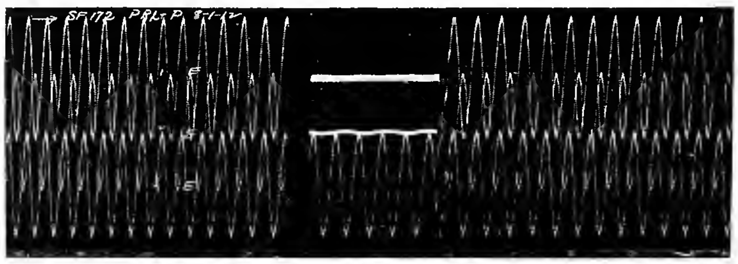
TEST "A."

Switching Off Line No. 57604 by Opening Form H-3, 57,000-Volt Oil Switch at Lincoln Substation, Line Open at Station "M."



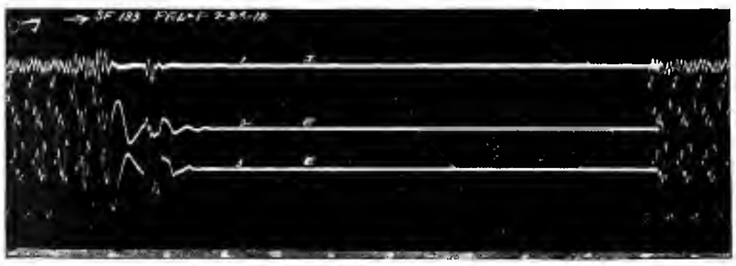
TEST "A."

Switching Off Line No. 57604 by Opening Form H-3, 57,000-Volt Oil Switch at Lincoln Substation, Line Open at Station "M."



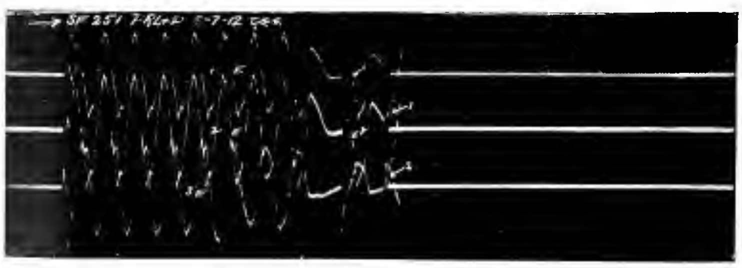
TEST "A."

Switching on Line No. 57604 by Closing Form H-3, 57,000-Volt Oil Switch at Lincoln Substation, Line Open at Both Ends.



TEST "C."

Switching Off Line No. 57604 by Opening Form K-10 Oil Switch at Station "M." Transformers Connected to Line at Lincoln Substation.



TEST "D."

Switching On Line No. 56704 by Closing Form H-3, 11,000-Volt Oil Switch at Lincoln Substation, Line Open at Station "M."

Line energized from Station "M." Transformer neutral grounded.

Observations made at Lincoln Substation.

Note: Fuse of about 15 feet of No. 30 B. & S. gauge copper wire was connected between lower leg of line and ground near Lincoln Substation. The short circuit was not sufficient to automatically open oil switches at Station "M." Lightning arrester discharged at Lincoln Substation. Oscillograph vibrator used in curve No. 1 broke.

Curve 1—E = Potential between upper leg of line and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 89% above instantaneous maximum of normal wave.

Curve 2—E = Potential between lower leg of line and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 75% above instantaneous maximum of normal wave.

Curve 3—E = Potential between middle leg of line and ground, 300:1 ratio potential transformer. Peak value of potential to ground = 45+% above instantaneous maximum of normal wave.

TEST "G."
Switching On Line No. 57604 by Closing Form K-10 Oil Switch at Station "M," Line Fused to Ground at Lincoln Substation.

Line energized from 60-Cycle System at Lincoln Substation.

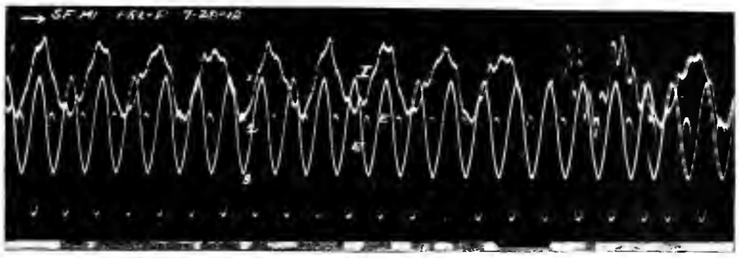
Observations made at Station "M."

Note: During this test transformer No. 3 was connected to line at Station "M." Neutral grounded through about 10 feet of No. 10 B. & S. gauge Climax resistance wire. Oscillograph vibrator used in Curve No. 1 was connected across resistance in ground connection of transformer neutral.

Curve 1—I = Current in neutral connection between transformer and ground (see note). Peak value of current in transformer neutral = 5 amperes approx.

Curve 2—E = Potential between middle leg of line and ground, 300:1 ratio potential transformer. No rise of potential to ground.

Curve 3—E = 57,000-volt sta. bus potential, 500:1 ratio potential transformer. No rise of bus potential.



TEST "H."
Charging Lightning Arresters on Line No. 57604 at Station "M."

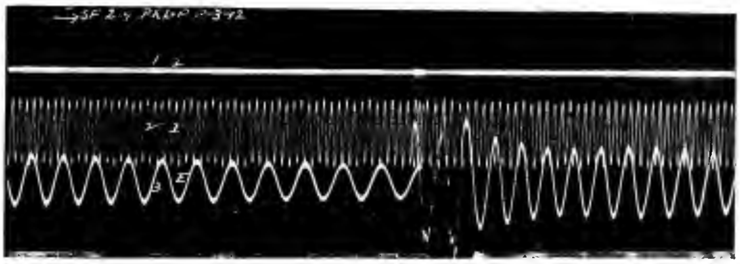
Line energized by 60-cycle system at Knott Substation.
Observations made at Station "G."

Note: During this test, 60-cycle lighting load was connected to line No. 57602 at Tabor and Lents substations.

Curve 1—I = High tension line current = 0.

Curve 2—I = Current in neutral connection to ground of 3 — 1250 kw. Single-phase transformers energized from Station "G." No rise of neutral current.

Curve 3—E = Potential between one leg of line No. 57602 and ground, 300:1 ratio potential transformer. Curve No. 3 shows gradual decrease of voltage due to rotating machinery on line.



TEST "J."
Switching Off Line No. 57602 by Opening Form H-3, 57,000-Volt Oil Switch at Knott Substation. Line Open at Station "G."

Line energized from Station "M."

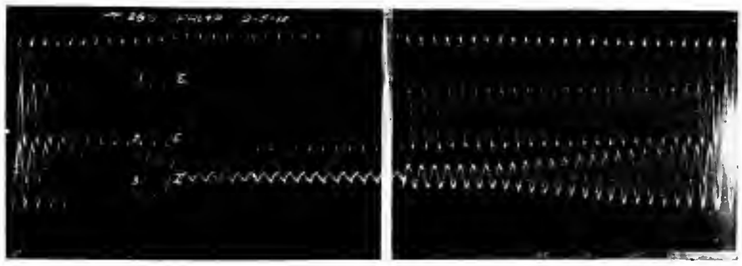
Observations made at Lincoln Substation.

Note: During this test, 60-cycle system at Knott Substation was connected to line No. 57602, energized from Station "G," and line No. 57604 through cable No. 11613, to Lincoln Substation.

Curve 1—E = Potential between upper leg of line No. 57604 and ground, 300:1 ratio potential transformer.

Curve 2—E = Potential between middle leg of line No. 57604 and ground, 300:1 ratio potential transformer. Normal potential to ground = 32,700 volts effective, taken from reading on voltmeter connected to potential transformer used in curve No. 2.

Curve 3—I = Current in one leg of cable No. 11613, 60:1 ratio current transformer. Peak value of current = 170 amperes approx.



TEST "P."
Opening Line No. 57604 With Townsend Air Break Switch at Lincoln Substation While Carrying 1000 Kw. Load.

and is shown to be a very pronounced eleventh harmonic superimposed upon a 60-cycle fundamental.

O. Switching off and on open line by air break switch.

These tests were made with a special type air break switch, designed by Mr. Townsend. The switch satisfactorily opened the line charging current a number of times, and the average results in voltage rise were approximately the same as obtained when switching with the Form K-10 switch. Since the switch is manually opened by turning a crank, the time of opening varies with the speed at which the crank is turned, taking over half a second in some instances.

P. Opening line with air break switch when carrying load.

Owing to the proximity of the line wires to the horn gaps, this test was not successful above 1000 kilowatts. This amount of load was successfully opened, however, without great voltage distortion.

The current on the low tension side of transformers feeding the transmission line during the period of opening line under load is shown in Record No. 268. The current gradually increases to maximum while the switch is opening, and gradually drops off until the circuit is opened, when the current shown represents transformer exciting current. This increase in current, no doubt, represents the current required to maintain synchronism between the two circuits during the opening of the switch.

Q. Time of closing switch contacts.

One of the 11,000-volt Form H-3 oil switches was tested with reference to the time of making or breaking contact on the three poles of the switch. When

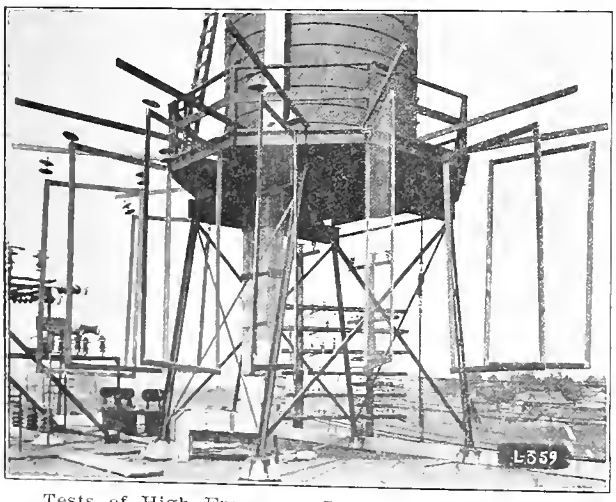
testing with 110 volts it was found that the contacts were not permanently made. The time elapsing between closing of first and last contact was found to be as great as one cycle. The switch was also tested with 11,000 volts, and the smaller wave shown is the charging current of condenser effect in potential transformer winding.

Natural period of transmission line.

The charging current of the transmission line was measured with a series ammeter and found to be approximately 6 amperes under normal conditions of voltage and frequency. The capacity of a transmission line as calculated from the charging current is C.279 m.f. The calculated inductance of the transmission line is 59.3 m.h. The natural period of the line, as calculated from these values, is approximately 1950 cycles per second, or 32½ times the fundamental. When one transformer is connected to the line, the natural period is reduced to approximately 1260 cycles per second. These frequencies are not much greater than the values commonly obtained in the test. No attempt has been made to calculate natural periods further than this, and with the system connected the calculations become complex. The presence of the 33-cycle parallel lines may have some effect upon the natural period of vibration. Another condition which has been suggested as a possibility in causing insulator failures is the presence near the transmission line at Lents Junction of a wireless station of considerable magnitude. This has not been investigated.

Conclusions.

The highest line voltage obtained during the entire series of tests represents approximately 180,000 volts instantaneous value, or 104,000 volts instantaneous value to ground. As the suspension insulators are tested at 90,000 to 100,000 volts per unit, it would seem that the tests did not reveal any justifiable cause for insulator failure, due to voltage rise caused by switching, charging arresters, or other operating conditions. The results, however, do indicate that a large factor of safety is required in the spacing of conductors in stations and substations, and in the results of apparatus connected directly or indirectly to the high tension lines. There are also certain conditions which have not become definitely defined under which low frequency surges may take place affecting the entire system. It is very clear, as has been pointed out before in other investigations, that it is much preferable to carry on switching operations on the low tension side of the transformers rather than with the high tension oil switches. Also, in connecting the line to the system by closing a low tension oil switch, only one transformer or bank of transformers should be used, if possible, in order to reduce the rush of transformer exciting current.



Tests of High Frequency Surges Apparatus Constructed at Portland to Test Pressure of Frequency Surges Higher Than Those on Oscillograph Records.

A full description of a similar series of tests and of the method of using the oscillograph for making these tests may be found in the proceedings of the A. I. E. E. for July, 1911, on Page 1621, in a paper by Mr. G. Faccioli.

PRESIDENT TAFT'S RECOMMENDATION ON WATER POWER.

There are pending before congress a large number of bills proposing to grant privileges of erecting dams for the purpose of creating water power in our navigable rivers. The pendency of these bills has brought out an important defect in the existing general dam act. That act does not in my opinion grant sufficient power to the federal government in dealing with the construction of such dams to exact protective conditions in the interest of navigation. It does not permit the federal government, as a condition of its permit, to require that a part of the value thus created shall be applied to the further general improvement and protection of the stream. I believe this to be one of the most important matters of internal improvement now confronting the government. Most of the navigable rivers of this country are comparatively long and shallow. In order that they may be made fully useful for navigation there has come into vogue a method of improvement known as canalization, or the slack-water method, which consists in building a series of dams and locks, each of which will create a long pool of deep navigable water. At each of these dams there is usually created also water power of commercial value. If the water power thus created can be made available for the further improvement of navigation in the stream, it is manifest that the improvement will be much more quickly effected on the one hand, and, on the other, that the burden on the general taxpayers of the country will be very much reduced.

In my opinion constructive statesmanship requires that legislation should be enacted which will permit the development of navigation in these great rivers to go hand in hand with the utilization of this by-product of water power, created in the course of the same improvement, and that the general dam act should be so amended as to make this possible. I deem it highly important that the nation should adopt a consistent and harmonious treatment of these water power projects, which will preserve for this purpose their value to the government, whose right it is to grant the permit. Any other policy is equivalent to throwing a a most valuable national asset.

ELECTRICAL PUMPING AND IRRIGATION

DEPTH OF CUT FOR CANALS IN LEVEL GROUND.

BY B. A. ETCHEVERRY.

Conveyance Losses of Water in Canals.

All irrigators are well acquainted with the fact that the losses in conveying water in earth canals are in many cases very large and with newly excavated canals are often so great that it is difficult to deliver water at the lower end. On irrigation systems with unlined canals, these losses usually range from 25 to 60 per cent of the water diverted or taken in the canal systems, and there are many instances where the losses are much greater. On some California canals losses of 64 per cent per mile have been observed. It is safe to state that on an irrigation system consisting of earth ditches only 50 per cent of the water diverted is delivered to the fields.

The water lost by seepage disappears through some underground drainage channel or raises the water table of the lands adjacent to and below the canal. This causes the waterlogging of the land or accumulation of alkali salts on the surface. This effect, combined with wasteful irrigation, has been the cause of over ten per cent of the irrigated lands of the West becoming unfit for crop production. On one project in eastern Washington after only the first irrigation season considerable land was waterlogged and in some portions the water table had risen sufficiently to cover the land several feet deep. These damages alone, in many cases, justify the expense of lining the canals. But even if injury by waterlogging is not considered, there are many localities where the water is sufficiently valuable to make the lining of canals to stop the loss of water, a paying proposition. The amount of money which one is justified in spending will be in proportion to the extent of the losses.

1. Extent of Seepage Losses in Canals.

The extent of seepage losses depends on many factors, such as porosity of the soil, the form of cross-section, the size of the canal, the number of seasons the canal has been operated, the amount of silt in the water, the velocity of flow, the depth to the water table, etc. The most valuable general observations as regards the amount of these losses are those of the Irrigation Investigations Office of the United States Department of Agriculture. From series of measurements on seventy-three ditches in the Western States they have found that the average loss per mile of ditch is 5.77 per cent of the entire flow; the measurements range from a maximum of 64 per cent per mile to a slight gain in a few cases. Large canals in general lose less in proportion than small ones. The measurements show that the loss per mile averages about 1 per cent for canals carrying 100 cubic feet per second or more, about 2½ per cent for canals carrying 50 to 100 cubic feet per second, 4½ per cent for canals carrying 25 to 50 cubic feet per second, and 11¼ per cent for canals carrying less than 25 cubic feet per second.

For some purposes it is preferable to know the extent of seepage expressed in cubic feet of water per day per square foot of wetted area of the canal. This is equivalent to stating the depth of water in feet lost each day. A number of measurements have been made in various parts of the country, and some of these have been assembled by F. W. Hanna, project engineer of Boise Project, United States Reclamation Service in Idaho, who states that from careful consideration of the data assembled it would appear that a seepage loss of 0.5, 1 and 1.5 cubic feet per square foot of wetted surface per day might be assumed for canal losses respectively for rather impervious, mediumly impervious and rather pervious soils. Based on the above figures and for canal cross-sections generally used for laterals in earth, he has obtained the values given below for the seepage loss per mile, expressed in per cent of flow. The form of the cross-section is based on the following assumptions: (1) Relation of bottom width of canal; (b) to depth; (d) is $b = 1.5d^2 + 1.5$, and not less than 3 ft.; (2) Side slopes, 2 to 1; (3) mean velocity is equal to 2 ft. per second.

Dimensions of Canal.					Seepage Losses.			
Depth.	Bottom width.	Area.	Wetted perimeter.	Capacity.	Sec. ft. per mile for S=1.	Per cent lost per mile. for S=0.5.	for S=1.0.	for S=1.5.
0.5	3	2	5.24	4	0.31	4.0	8.0	12.0
1.0	3	5	7.48	10	0.45	2.3	4.5	6.8
1.5	5	12	11.72	24	0.70	1.5	2.9	4.4
2.0	8	24	16.96	48	1.02	1.0	2.1	3.1
2.5	11	40	22.20	80	1.33	0.8	1.7	2.5
3.0	15	63	28.44	126	1.71	0.7	1.4	2.1

S = rate of seepage in cubic feet per square foot of wetted surface per day = 0.5 for rather impervious soil, 1.0 for mediumly impervious, and 1.5 for rather pervious soils. From the above computations Mr. Hanna has prepared the following table of general values for designing irrigation laterals.

Seepage Values for Designing Irrigation Laterals.

Capacity of Canal. Cu. ft. per second.	Loss in per cent of flow per mile. For rather impervious soil.	Mediumly pervious soil.	Rather pervious soil.
10 or less	4	8	12
11 to 25	2.5	4.5	7
26 to 50	1.5	3.	4.5
51 to 75	1.	2.	3.
76 to 100	.75	1.5	2.5

The above table gives results which agree with those obtained by the Irrigation Investigations Office as closely as can be expected because of the numerous factors involved.

2. Evaporation Loss from Water Surface of Canals.

The losses above stated include seepage and evaporation, but, contrary to the general belief, the losses of evaporation from flowing water in a canal are insignificant compared with those of seepage. It has been shown that the losses of seepage and evaporation per day might be assumed at 0.5, 1 and 1.5 cubic feet of water per square foot of wetted surface, respectively, for rather impervious, mediumly impervious and rather pervious soil. These are equivalent to losses of water 6, 12 and 18 inches deep. As compared to these figures, the evaporation from water surface for the irrigation season will generally be

about one-quarter of an inch per day, which is from 25 to 75 times less than the above seepage losses. Seepage and evaporation measurements made at Twin Falls, Idaho, and reported by Elias Nelson (Bulletin 58, University of Idaho) show that the evaporation ranged from less than 1 per cent to less than 2 per cent of the total loss in the canals. On one of the largest systems in the San Joaquin Valley, California, the total length of canals is 165 miles, and the total seepage loss was 28 per cent, and 30 times greater than the evaporation loss. These and other numerous experiments show that the evaporation losses in the conveyance of water are so small as compared with the seepage losses that they are of no importance.

Prevention of Seepage Losses in Canals.

To prevent the loss of water in conveyance, lining the canals with different materials has been tried. Those used or experimented with are concrete, wood, asphalt, oils, and clay puddle. A good lining should fulfill the following requirements: It should be watertight, prevent the growth of weeds, stop burrowing animals, be strong and durable, and preferably not affected by the tramping of cattle. From investigations made by the writer in 1906, and from more recent experience as regards the efficiency of the different types of linings, the following results can be anticipated:

Lining Plastered Without Forms, Gage Canal, Riverside, California.

First—A good oil lining, constructed with heavy asphalt road oil, applied on the ditch sides and bed at the rate of about three gallons per square yard, will stop 50 to 60 per cent of the seepage.

Second—A well-constructed clay puddle lining is as efficient as a good oil lining.

Third—A thin cement mortar lining about one inch thick, made of one part cement to four of sand, will prevent 75 per cent of the seepage.

Fourth—A first-class concrete lining, three inches thick, made of one part of cement to two of sand and four of gravel, will stop 95 per cent of the seepage.

Fifth—A wooden lining, when new, is as efficient as a concrete lining, but after two of three years repairs and maintenance will become an important item, and by the end of eight or ten years it will necessitate complete renewal.

The cost of an oil lining, where oil can be bought at California prices (about 2 cents a gallon) is about ½ cent per square foot. Cement mortar lining one inch thick costs about 3 to 4 cents per square foot. Cement concrete two inches thick costs about 6 to 8 cents, and three inches thick about 8 to 10 cents a square foot. These prices do not include the trimming and preparation of the ditch before the lining is put on, which would add from ¾ to 1½ cents per square foot. The cost of a clay lining depends greatly on the nearness of the canal to suitable clay. If clay is close at hand, it can be hauled and spread on the canal, then either tramped in by cattle or worked in by dragging chains over it, at a cost of less than 1 cent per square foot, but there are localities where money enough has been spent on clay linings to pay for a good concrete lining. Wooden lining has been used in very few cases, and the cost of such a lining, built of 2-inch lumber nailed on sills and side yokes, will not be less than that of a 2-inch concrete lining, and it will not be nearly as durable.

The disadvantages of the cheaper linings are the following: An oil lining stops only a part of the seepage losses, and while it will resist erosion well, it probably will not prevent the growth of weeds for more than one season unless a high velocity is used, and it will not stop the activities of burrowing animals. Oil linings have not been sufficiently tested to determine their durability.

Clay puddle will not prevent the burrowing of animals, and weeds grow rapidly, especially since the velocity of the water must be small in order to prevent the eroding or washing of the lining.

A concrete lining has none of the above disadvantages, and it meets the requirements of a good lining better than any other material. The only objection is its higher first cost. This, however, can be partly balanced, especially on side hill work, where a new canal is to be constructed by using a higher velocity and a smaller cross-section, thus decreasing the cost of excavation. Where an old canal must have its capacity enlarged, this may be done either by lining the canal, which will give a higher velocity because of the smoothness of the channel, or by increasing the cross-section by excavation. The cost of extra excavation, especially on side hills through hard material, may be greater than the cost of lining.

Concrete lining will in many cases prove to be the most economical type of lining. However, where good clay is available, and where it is not financially feasible to use concrete, clay puddle may be used to advantage in improving leaky earth canals when the velocity of flow is under three feet per second.

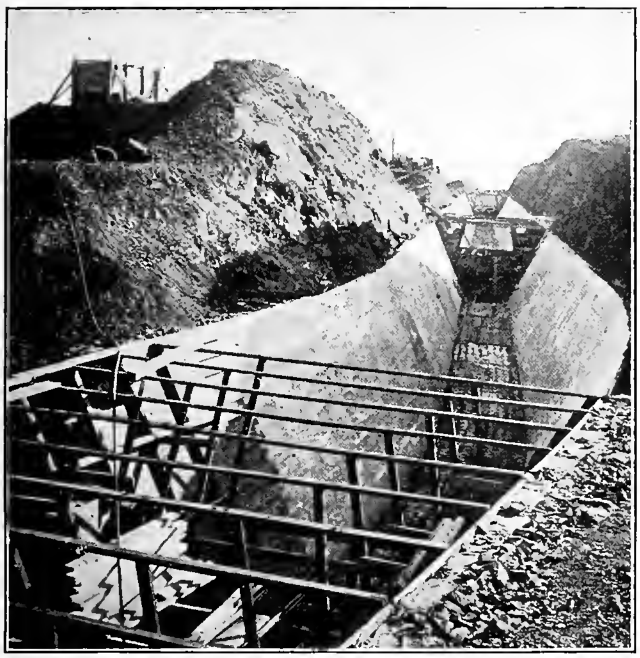
1. Concrete Linings.

The earliest use of concrete linings was in Southern California, about 1880, when the increasing value of water made it necessary to do away with losses. Since that time practically all of their canals, which are comparatively small, carrying less than 100 cubic feet per second, have been lined with concrete, and in some cases replaced with concrete pipes. Until recently very little concrete lining had been done outside of that region, but during the last few years concrete-lined canals have been constructed on many of the projects of the United States Reclamation Service

and on numerous private projects. There are now several examples in California, Oregon, Nevada, Washington, Idaho and other states, and during the past two years some excellent work has been done in British Columbia.

Form of Cross-Section and Thickness of Lining.

Unlined canals in earth are usually constructed broad and shallow, with the side slopes varying according to the character of the soil. This may be as steep as ½ horizontal to 1 vertical for hardpan or very firm soil, or as flat as 2 to 3 horizontal to 1 vertical for loose sandy soil. For a lined canal it is more economical to use a comparatively narrow deep section and fairly steep side slopes. This reduces the excavation and the amount of concrete. The side slopes must not be much steeper than the slope on which the ground will stand, or else the earth pressure, which has a tendency to push the side in, must be considered and the side lining designed as a sloping retaining wall. The slope of the sides and the thickness of the lining are therefore related and depend on the depth of the canal, the character of the method of construction and permanency. Generally the flatter the side slopes the thinner can the lining be made. When the lining is placed on the natural slope of the ground, as it resists no earth pressure, it can be made very thin, and in Southern California fairly satisfactory results have been obtaind on many systems with linings on inch or less in thickness. One example of very thin linings where there are low winter temperatures is a canal near Hanford, in Eastern Washington, which is lined for four miles with a concrete lining from ½ to 1½ in. thick. The lining was rather badly cracked, but this was largely due to poor workmanship. It was sufficiently efficient, however, to carry water over this length of the canal without appreciable loss, which was impossible before its construction. But even where the conditions are as favorable as in Southern California, a thickness of 1½ in. should be used as a minimum, and preferably 2 or 3 in. Linings 1 to 3 in. thick have been entirely satisfactory in Eastern Oregon, Eastern Washington and British Columbia, where the temperature has been as low as 20° and 30° below zero. Where the side slopes of the lined section are to be made steeper than the natural slope of the earth, the thickness should be sufficient to resist the earth thrust. To compute this the following formulae for normal earth pressure against the side lining, and known as Coulomb's Formulae, are reproduced.



Construction of Canal Lining for Truckee-Carson Project, Nevada.

First—For earth pressure with no surcharge—

$$P = \frac{1}{2} wh^2 \frac{\sin^2 \frac{1}{2} (\theta - \phi)}{\sin \theta \sin^2 \frac{1}{2} (\theta + \phi)}$$

Second—For earth pressure with maximum surcharge—

$$P = \frac{1}{2} wh^2 \frac{\sin^2 (\theta - \phi)}{\sin^3 \theta}$$

In both these equations P = normal earth pressure; w = weight of earth in pounds per cubic foot; h = vertical height of the side lining; θ is the slope angle made between the side wall and the horizontal ϕ = natural angle of slope of the earth. The overturning moment P is equal to P multiplied by its lever arm, which is equal to one-third the length of the side lining measured on the slope. This overturning moment must be balanced by the moment of the weight of the side lining. The following thicknesses of concrete linings are safe, according to the above formulae, and agree with good practice.

Thickness of lining in inches.	Side slope of canal.	Natural slope of repose of earth.	Maximum depth of Canal. With maximum surcharge.	With no surcharge.
3	½ to 1	1 to 1	4.5	14.0
3	½ to 1	2 to 1	1.0	2.75
3	1 to 1	2 to 1	4.0	8.5
3	1 to 1	3 to 1	1.75	4.0
2	½ to 1	1 to 1	3.0	9.50
2	1 to 1	2 to 1	2.75	5.50
2	1 to 1	3 to 1	1.25	2.75

Shrinkage and Expansion.

No matter what the thickness is, unless the concrete is reinforced with steel, or expansion joint provided, cracks are to be expected, because of the contraction or shrinkage in winter. These cracks will usually be fine cracks, occurring at more or less regular intervals, and the leakage through them will be small, and often they probably silt up. For better appearance and to distribute the cracks at uniform intervals, the lining should be laid in sections or strips 6 to 8 ft. long.

Effect of Frost.

Frost should have no effect on the lining if the soil is well drained. But when the soil contains water, freezing will produce heaving of the soil, which will not be resisted even by thicker linings than those recommended. Usually a canal which must be lined is located where the water drains too readily from the soil, but if the canal is located where water is liable to collect behind the lining, a drain should be provided. The drain should be a 3 or 4-in. tile placed below the floor of the canal lining in a trench 12 in. deep, located along the center line of the canal, and the tile covered preferably with loose rock, gravel, sand, or other porous material. To discharge the water collected, cross drains should be placed every 400 or 500 feet, or wherever there is a drainage channel.

JOURNAL OF ELECTRICITY
POWER AND GAS

PUBLISHED WEEKLY BY THE

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895.
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Entry changed May 1, 1906, to "The Journal of Electricity, Power and Gas," Weekly.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Distributing Electrical Apparatus

Thirty years ago there was but two factors in the electrical business, the manufacturer and the central station, the latter having been invented and promoted by the former. There were no dealers, jobbers or contractors. The central stations wired the houses and sold the lamps, no other current-consuming devices then being made. A single channel sufficed to carry the goods from the maker directly to the user.

Later there came a great flood of electrical appliances. New channels of trade were suddenly opened and the electrical contractor, jobber and dealer became an integral part of the great distribution system. They were necessary to carry on the surplus business which is still rapidly increasing. The central station gladly relinquished the actual sale and installation of apparatus in the thought that its selling energies could best be devoted to furthering the use of electric power.

Because of the perplexing problems of the mutual relations of these various interests, the advisability of the central station again adopting its original policy has frequently been raised. The central station is most vitally interested in the grade and character of devices put on its circuits and naturally wishes to maintain a general supervision. Where the contractors and dealers are willing to co-operate with the company little trouble is experienced, and in other cases a liberal education seems necessary.

No improper motives must be ascribed to any of the parties involved. As the engineer dams a great river, leads off its waters through ditches and flumes to the places most needed, so are the farseeing men of the electrical industry patiently and carefully striving to divert the proper distribution of electrical goods through the national channels.

High Tension Switches

The Portland Railway, Light & Power Company's steel tower transmission line representing the latest word in design, has, during recent months, experienced some difficulties from the failure of insulators of the suspension type. Oscillograph investigations have proven that the failure does not result from undue surges in the opening and closing of the high tension and low tension lines, the charging of lightning arresters, or other operating conditions. Though these investigations have proven fruitless in this regard, yet interesting subsidiary deductions may be drawn.

In the course of these tests it was found that the effect upon the voltage conditions is most pronounced at the station or system to which it has been or will be connected. Indeed, in some cases the voltage rise exceeded that on the transmission line itself. Hence, it is imperative that a large factor of safety be allowed in the spacing of conductors in stations and substations.

From the data collected in these tests emphasis is again laid upon the importance of carrying on the switching operations on the low tension side of the transformers rather than with the high tension oil switches. Caution should also be observed in con-

necting the line to the system when closing a low tension oil switch by using only one transformer or bank of transformers in order to reduce the rush of transformer exciting current.

The data gathered in this test relative to telephone lines, in view of the investigation by the power and telephone companies now under way in California, is also interesting. During this particular test, one leg of the telephone line was grounded on the line side of the insulating transformer. The oscillograph record thus taken indicates a pronounced eleventh harmonic superimposed upon a 60 cycle fundamental. At Morgan Hill, in California, the Bell Telephone Company is taking data upon the Coast Counties Gas & Electric Company's transmission line. The Sierra & San Francisco lines are now under construction at this point. It will be interesting to note the combined effect of two high tension transmission lines operating at different voltages and slightly differing frequencies.

Fundamental Principles of the Diesel Engine

Rumors of the near initial bow of Diesel engine operation on the coast are rife on all sides. The early arrival is certain; for, as in the foretelling of the coming of the Mesiah, "we have seen his star in the East." Yet the fact remains that, as perfect as are the thermodynamic principles upon which the Diesel engine is based and, as glowing as are authentic accounts of European and Eastern practice today, nevertheless, not a single Western installation can vaunt the hand of victory to the rows of doubting Thomases.

During the past fortnight a noted expert has turned down the proposed Diesel engine installation at the Alameda municipal plant situated at Alameda, California. Until the proponents of Diesel practice can come out in the open and actually show to the cautious engineer the throbbing engine in operation, until he can exhibit the cost sheets, the economy curves and the like taken from operation by California oils such conservatism must be expected.

The thermodynamic principles upon which the Diesel engine operates are interesting. In the ordinary gas engine, a mixture of air and gas is drawn in from without and then compressed. At the completion of compression, a spark causes the gaseous mixture, thus compressed, to ignite. The enormous heat given out by combustion, immediately raises the resulting gases to a high temperature. In the elementary study of gases and their thermodynamic behavior we learn that when heat is added and the volume cannot be increased, there results an increase in pressure proportional to the increase in absolute temperature of the gas. Hence, although this gaseous mixture has been previously compressed, yet it is now raised to a still higher temperature and pressure. As in the recoil of a highly compressed spring, this energy reservoir of compressed gases now supplies the heat necessary to perform the return stroke, in which the piston head is pushed forward, thus driving the engine mechanism.

In the Diesel operation the principle is considerably different. Instead of compressing a mixture of air and gas, only the air itself is compressed. Compression, however, is much more complete. So much so, in fact, that the temperature of the air is raised higher than the flash point of the particular oil fuel to be used. It is evident, too, that when oil is now sprayed into this heated air mixture, ignition will take place without the use of a spark. Hence, under the Diesel principle, it is not necessary to instantaneously explode the entire charge, but if the oil is properly sprayed in, the combustion may be made to extend over a portion of the return stroke, in such a manner that an isothermal relationship, or equal-temperature of the gas content, is maintained until combustion is complete.

Years ago, Carnot announced the principle that the motive power of heat is independent of the agents employed. Indeed, it is determined solely by the temperatures of the bodies between which the cyclic transfers of heat occur. The Carnot cycle, in which the gas expands isothermally for a portion of the stroke completing its expansion adiabatically or without heat being added or taken from the gas during the latter portion of stroke, can be shown to be the most perfect ever to be anticipated. In this cycle the gas is brought back to its original state in the engine cylinder by similar compressive laws. The Diesel cycle differs in the return stroke only. For instance, instead of being compressed isothermally and then adiabatically, the mixture exhausts under constant volume and is then compressed adiabatically.

In actual practical operation the Diesel engine uses a considerable quantity of excess air. The pressure along the combustion line is from 450 to 600 lb. per sq. in. The pressure at which the oil is delivered is 750 lb. per sq. in. and the temperature at the end of compression approaches 1000 degrees F. There is no uncertainty as to the time of ignition; it begins immediately upon the entrance of the oil into the cylinder. To avoid pre-ignition in the supply tank, the high-pressure air used to inject the oil must be cooled. Thermodynamically, the engine operates more efficiently on light loads than heavy and its cycle of operations is, on the whole, more efficient than the usual gas engine cycle.

The field of usefulness for this threatening giant in the power field is far-reaching. Sane and sound judgment, however, demands that we withhold final decision as to Western applications until California oils of usual gravity range can be shown to successfully and economically drive this mechanism.

Amendment No. 34

The defeating of Amendment No. 34 at the recent San Francisco polls is truly to be regretted. Here is a city which has employed the ablest counsel in framing a progressive franchise policy, and yet in face of its findings and advice, turns down this mature and highly scientific enabling clause as proposed. The passing of the civic center enactments and other propositions relative to the Panama-Pacific Exposition are the only happy thoughts arising from serious reflection concerning the vote of last Tuesday.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

G. I. Kinney, Pacific Coast manager of the Fort Wayne Electric Works, is at Los Angeles.

Sidney Sprout, consulting electrical engineer at San Francisco, spent the past week at the properties of the California Oregon Power Company.

Frank J. Quinn has opened offices in the Atlas Building, San Francisco, as Pacific Coast representative of the Manhattan Electric Supply Company.

W. F. Neiman, general sales manager for the Great Western Power Company, has also assumed the duties of manager of the City Electric Company of San Francisco.

L. H. Newbert, manager of appliance department of the Pacific Gas & Electric Company, is expected to return from the convention of the National Commercial Gas Association, this week.

F. E. Geibel has taken his former position in the electrical engineering department of the Southern Pacific Company at San Francisco after two years' absence spent at his home in Alabama.

George Scarfe, superintendent of the Nevada City power division of the Pacific Gas & Electric Company, presented a paper before the California Miners' Association convention at San Francisco this week.

W. L. Locke, engineer with the Stone & Webster Construction Company in charge of transmission line construction for the Big Creek plant of the Pacific Light & Power Company, was at San Francisco this week.

Tsunetaro Kujirai. assistant professor of electrical engineering at the Imperial University at Tokyo, was a recent interested visitor at the electrical departments of Stanford University and the University of California.

George S. Johnson, formerly a designing engineer with the Great Western Power Company in charge of substation design of its northwestern division, is now design assistant to **S. Barford**, engineer of the Oro Electric Corporation.

W. D. A. Ryan, illuminating engineer with the General Electric Company, gave a talk on the proposed plans for the illumination of the Panama-Pacific Exposition on December 11, before the San Francisco members of the American Institute of Electrical Engineers and the Electrical Development League.

Kempster B. Miller has been at Bend, Oregon, in connection with the purchase of the control of the Bend Water, Light & Power Company by McMeen & Miller of Chicago and their associates. It is understood that **J. P. Keyes**, who has had charge of the hydroelectric plant on Deschutes River, will continue in that capacity. Plans are being prepared to enlarge the electric and the water plants.

Sidney R. Inch, at present general manager of the Missoula Light & Water Company, will, beginning with January first, assume the duties of general superintendent of the recently formed Utah Power & Light Company at Salt Lake City. This company is a consolidation of a number of companies operating in Utah, Idaho and Colorado, the most important of which is the Telluride Power Company. The combined properties have about 1000 miles of high tension transmission lines, a plant capacity of over 100,000 h.p. and have water power resources for the development of as much again. As recently announced in the press, the Denver & Rio Grande Railroad is going to electrify its mountain section. The Utah Power & Light Company will furnish the power for it.

MEETING NOTICES.

Oregon Jovians.

In connection with the convention of the Oregon Electrical Contractors at Portland, December 17-19, a Jovian rejuvenation will be held at the Multnomah Hotel on December 19. A supper was recently served at the Bowers Hotel to about fifty Portland electrical men when arrangements were started for this rejuvenation, the third this year. George R. Sailor of the Westinghouse Electric & Manufacturing Company, is Statesman and J. E. Davidson of the Pacific Power & Light Company alternate.

Electrical Development League.

The second semi-annual meeting of the Electrical Development League of San Francisco was held December 10th. The election of officers for the ensuing six months' term resulted in the selection of T. E. Bibbins as president; C. C. Hillis, vice-president, E. B. Strong, secretary-treasurer. Members of the executive committee also elected were W. L. Goodwin and P. C. Butte. Mr. Bibbins in addressing the meeting on his election to the presidency of the organization made an earnest plea for the more active participation and interest on the part of the central stations as well as the manufacturers and contractors in the affairs and welfare of the League.

Pacific Northwest Society of Engineers.

Plans have been made for the annual dinner and meeting of the Pacific Northwest Society of Engineers, at the New Washington Hotel, Seattle, Saturday evening, January 4, at 7 o'clock. The annual election will be conducted by mail. Two or more candidates have been nominated for most of the important offices. C. W. Harris, assistant professor of engineering at the University of Washington, read a paper on "Determining the Diameter of Pipe Lines, the Theory and Method of Application," at the last meeting.

Portland Section A. I. E. E.

The next regular meeting of the Portland Section of the A. I. E. E. will be held on December 17, 1912, in the assembly hall, Electric Building. The speaker will be Mr. L. D. Gilbert, Cement Engineering Company, on the subject of "Electricity as a factor in the development of the Cement Industry."

The Portland Section of the A. I. E. E. have written to all the other Pacific Coast Sections, suggesting that the Sections of the Coast get together and nominate a prominent Pacific Coast member for the office of vice-president.

Portland Engineers and Architectural Club.

The joint luncheon of the Engineers and Architectural Clubs of Portland was held at noon Tuesday, the 3d, at the Portland Hotel. The chairman being Mr. A. S. Moody, and the speaker Hon. E. E. S. Wood on the "Employers' Liability Law of Oregon." The unanimous vote of 110 members was received on the subject of the consolidation of the Oregon Society of Engineers and the Portland Architectural Club as regards headquarters.

Los Angeles Section A. I. E. E.

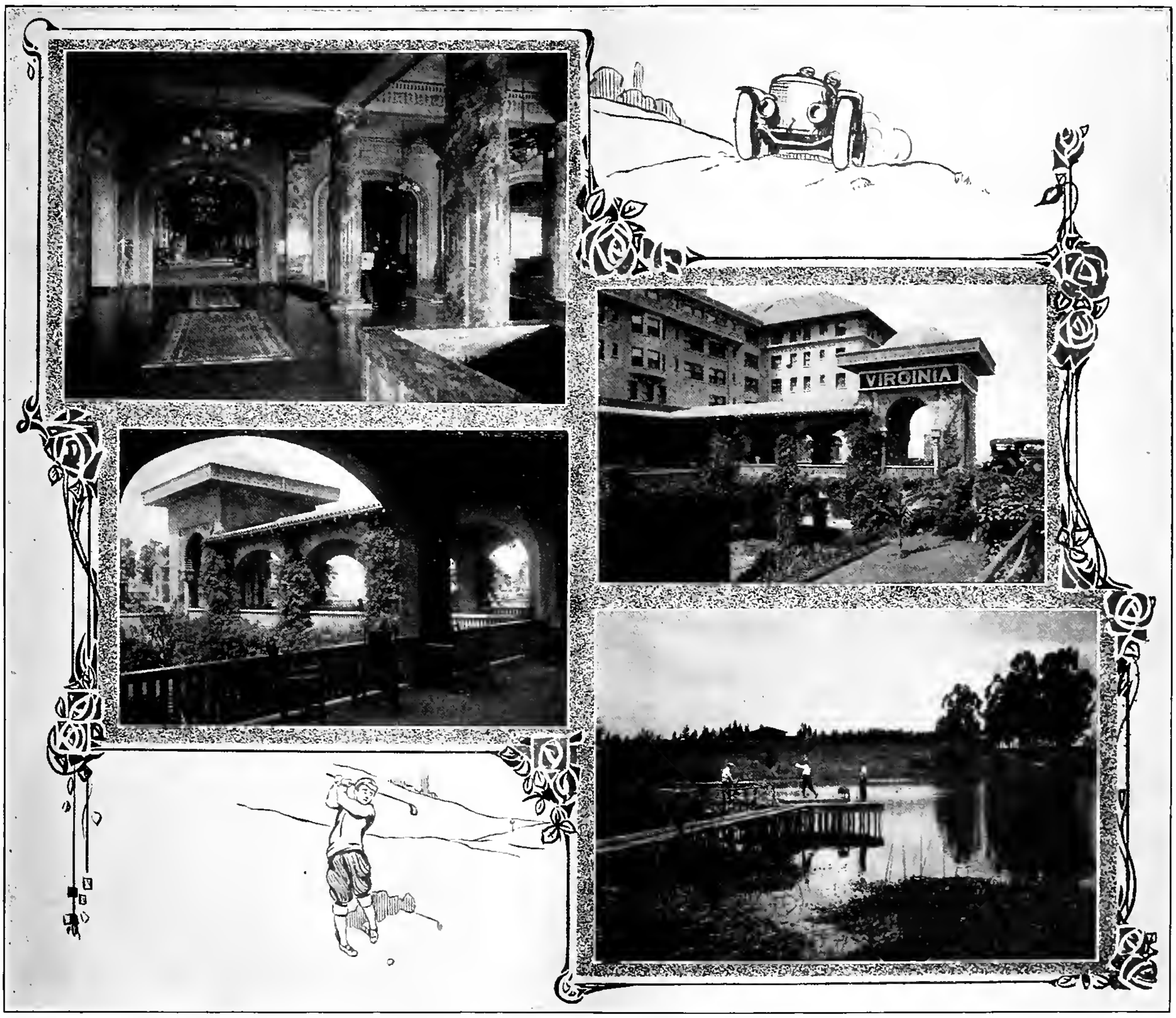
The Los Angeles Section of the American Institute of Electrical Engineers held its regular monthly meeting at Blancbard Hall, on Tuesday evening, November 26, 1912. There were present 40 members and visitors. President George A. Damon was in the chair. Before the paper of the evening, Prof. R. W. Sorenson, chairman of the program committee, announced W. D. A. Ryan of Schenectady, New York, could not be present, but he hoped to have him present to give his talk on "Illumination" for the next meeting. Mr. Damon then introduced F. W. Harris, who read a paper entitled "Oil Switches and Circuit Breakers." This proved a very interestng subject and brought forth much discussion by the following: E. W. Paul, J. E. Macdonald, C. A. Howell, Ed. Woodbury, R. W. Sorenson, D. D. Morgan, A. W. Nye. The meeting then adjourned.

ELECTRICAL JOBBERS' MEETING.

The Pacific Coast Electrical Jobbers' Association met in regular quarterly convention in Southern California during the week of December 7th. The program was slated for the Hotel Avalon, Catalina Island, but whether it was the weather man or the genial secretary and chairman of entertainment, Albert H. Elliott, who designed the most unique pre-convention entertainment, had not been decided when the meeting adjourned.

A Santa Ana sand storm, which Southern California claims occurs not oftener than once in five years, met the electrical jobbers, their guests the manufacturers, the ladies and one other. Never to mortal man or woman was a more welcome sight presented than that of the still waters of the harbor at sunset that evening.

We were too empty for utterance. Packed in a car already packed, we were silently taken to Long Beach. The ambulance corps, consisting of the bellboys of the Hotel Virginia, soon had the baggage in the rooms and a great transformation scene was about to be enacted. Bedraggled, begruntled, begrimed, and I might say be ———, we entered the dining room. The beautiful picture brought smiles to the faces



Pleasant Recollections of Long Beach.

visitors from the north and accompanied them across the channel. After three unsuccessful attempts to land at Catalina Island, the little steamer was headed back to the mainland, through the tossing, torturing waters. As one of the principal events planned for the meeting was to be a fishing contest, the irony of the situation was apparent while the fish were being fed. All had failed to bolt their breakfast.

As in all emergencies, the really great men spring to the front from most unexpected quarters, "Grandpa" Carter, the colonel of the regiment, flashed a few aerograms to the Hotel Virginia, asking that ambulances and provisions be provided for forty. The one word in answer, "sure" was sufficient.

If Los Angeles should ever need "boosters" for the beautiful harbor of San Pedro, they will but have to refer to the of all when the "me an' u" had been devoured with the rest of the good things that the pretty girls brought to us, there was not one that could remember that there had ever been a Santa Ana sand storm.

A meeting was immediately called to arrange the program. The good people of Long Beach came to the rescue with open arms. A most cordial invitation was extended to the visitors by the Virginia Country Club. This was accepted with a vote of thanks. Not only did they extend the true southern hospitality of presenting the links to the visitors in fee simple, but every member owning an automobile appointed himself as chairman of the entertainment committee, and saw that their guests were provided with cars at a moment's notice.

The Hotel Virginia can be congratulated upon its able

management and also on each individual employe. But what's the use of praise; we met in Southern California. Two joint meetings of the jobbers and manufacturers were held during which many happy thoughts were suggested, and a spirit of co-operation was established that cannot help but be of inestimable value to all.

These pleasant outings are today recognized as one of the most important factors by all business concerns.

The banquet Saturday evening, and the dance that followed, closed one of the most successful and largest meetings ever held on the Pacific Coast. The pool tournament was won by Miles Steel, and the golf tournament was as follows:

Friday, December 6, 1912.

Jobbers Eligible Only.

Ever Ready Cup.

	Gross Handicap.	Net.
C. B. Hall	111—16	95
N. W. Graham	117—22	95
†F. N. Averill	106—27	79
A. H. Elliott	117—16	101
F. H. Leggett	99—13	86
W. S. Berry	97— 1	96
C. C. Hillis	91— 5	86
H. V. Carter	100—13	87
C. R. Dedrick	121—23	98

Seaver Cup.

C. B. Hall	111
N. W. Graham	117
N. F. Averill	106
A. H. Elliott	117
F. H. Leggett	99
W. S. Berry	97
‡C. C. Hillis	91
H. V. Carter	100
C. R. Dedrick	121

Saturday, December 7, 1912.

	*Electrical Contractors' Association Cup. To be played for 10 times (1st time) Gross Handicap.	Net.	Jobbers' Perpetual Cup. Gross Handicap.	Net.	(3 time win.) Patten Cup. Gross Handicap.	Net.
†F. N. Averell	98—23	75	98—23	75	98—23	75
N. W. Graham	121—12	109	121—12	109	121—12	109
C. R. Dedrick	130—13	117	130—13	117	130—13	117
C. C. Hillis	92+ 7	99	92+ 7	99	92+ 7	99
H. V. Carter	94— 3	91	94— 3	91	94— 3	91
W. S. Berry	99+13	112	99+13	112	99+13	112
C. B. Hall	110— 8	102	110— 8	102	110— 8	102
F. H. Leggett	107— 7	100	107— 7	100	107— 7	100

(3 time win.) Manufacturers' Cup.

	Gross Handicap.	Net.
M. F. Steel	115—15	100
F. H. Poss	118—13	105
R. B. Clapp	107—12	95
T. E. Bibbins	95— 4	91
H. E. Sanderson	89+ 7	96
†Garnett Young	112—27	85
W. B. Hall	128—27	101
J. A. Herr	150—27	123

*The Pacific Coast Division of the National Electrical Supply Jobbers' Association:

Gentlemen: On behalf of the National State Association of Electrical Contractors, I take pleasure in handing you herewith a trophy, to be played for at the golf tournaments of your regular Pacific Coast meetings. The cup is to be the permanent property of anyone winning the same three times.

The rules as to what constitutes a win are contained in nine (9) sealed and numbered envelopes attached herewith. These envelopes are to be opened in their numerical order—one after each tournament has been played.

Trusting that you will find it interesting to have one more trophy for your golf competition, I remain,

Yours truly,

J. C. RENDLER, President.

†Winner.
‡Winner outright.

Those in attendance were:

F. N. Averill, Portland; Mr. and Mrs. W. S. Berry, San Francisco; T. E. Bibbins, San Francisco; F. E. Burger, Los Angeles; H. V. Carter, San Francisco; R. J. Davis, San Francisco; C. P. Dedrick, Portland; Albert H. Elliott, San Francisco; Frank Fowden, San Francisco; C. L. Gilson, Oakland; M. A. Graham, Los Angeles; S. B. Gregory, San Francisco; C. B. Hall, Los Angeles; Mr. and Mrs. Brewster Hall, San Francisco; Jas. H. Herr, San Francisco; C. C. Hillis, San Francisco; P. J. Hyde, San Francisco; Mr. and Mrs. F. H. Leggett, San Francisco; John M. Morris, Los Angeles; F. H. Murray, Los Angeles; F. W. Poss, San Francisco; H. E. Sanderson, San Francisco; Mr. and Mrs. H. B. Squires, San Francisco; Miles F. Steel, San Francisco; E. B. Strong of the Journal of Electricity; C. E. Wiggins, San Francisco; Garnett Young, San Francisco.

NEWS OF CALIFORNIA RAILROAD COMMISSION.

December 5.

A decision was rendered granting permission to the Ojai Power Company to issue $25,000 of stock for the construction of an electric light plant in Nordhoff, Ventura County. The company was also granted a certificate of public convenience and necessity to exercise franchise rights.

The application of the Coalinga Water & Electric Power Company for an order authorizing the expenditure of funds secured from bond sales was dismissed upon the request of applicant.

THE UTAH ELECTRIC CLUB.

The Utah Electric Club was organized with 140 charter members on December 5 at Salt Lake City. This new club is destined to become one of the leading commercial and technical organizations of the State. Its object is to promote the social intercourse, recreation and culture of the members, and to advance the commercial interests of Utah. Any person interested in any branch of the electrical industry may become a member.

The following board of directors was elected for the ensuing year: President, C. B. Hawley, manager of the Intermountain Electric Company; Vice-president, H. R. Bucks, chief electrician of the Oregon Short Line Railroad; Secretary-Treasurer, W. W. Torrence, manager of the General Electric Company, John Jones, manager of the Westinghouse Electric Company, H. M. Fennemore, of the Mountain States Telephone & Telegraph Company, Leo Brandenberger of the Telluride Power Company, B. W. Mendenhall, of the Utah Light & Railway Company, E. H. Eardley, of E. H. Eardley & Bro., R. S. Folland, manager of the Capital Electric Company.

Mr. Armstrong, president of the Commercial Club, invited the new organization to make its headquarters with the Commercial Club. This invitation was unanimously accepted.

The luncheon meetings will be held every Thursday noon at 12:15 in the Commercial Club Building.

H. T. Plumb, engineer of the General Electric Company, was elected chairman for December, H. F. Holland, of the Simplex Heating Company, chairman for January, and Bruce Cramer, chairman for February. These gentlemen constitute a program committee in charge of the weekly meetings.

OREGON ELECTRICAL CONTRACTORS' ASSOCIATION

A great deal of interest is being manifested in the forthcoming first annual convention of the Oregon Electrical Contractors' Association at Portland, December 17 and 18. The jobbers particularly, and their salesmen, are displaying a commendable spirit of co-operation and the visitors will be treated with a continuous performance in the way of entertainment by the sales force between the formal sessions.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

THE RELATION OF THE OREGON ELECTRICAL CONTRACTOR TO THE UNDERWRITERS' INSPECTION WORK IN OREGON.[1]

BY F. D. WEBER.

To accomplish these results would seem simple, and it would be if the defects were all "cut and dried" and always violated in one way.

Nevertheless we have a system which we believe is as near perfect as any can be made.

Exhibit "A" shows standard form of notice sent out. At both top corners are our office system of filing and insurance identification marks. Then comes the formal letter, followed by the street location. Below this follows a certificate of correction and instruction for the filling out and signing of same. And last a list of defects referred to by number.

EXHIBIT "A."

Sanborn Map
Block
Sheet
Map No.

UNDERWRITERS' EQUITABLE RATING BUREAU
559 SHERLOCK BUILDING
PORTLAND, OREGON

Page
Rating

ELECTRICAL INSPECTION REPORT

Under certain circumstances an electrical defect must cause fire. This fact being well established, we feel that it is only necessary to call your attention to the following described electrical defects in order that they may be remedied. May we rely on you to notify us within a reasonable time from receipt of this letter that the defects have been corrected and made to conform to the requirements of the National Electrical Code? Defects noted below have been reported as existing in electrical equipment of your property by our Electrical Inspector in his report

Secretary

City Owner

Street

Between and

Building Occupants

☞ The Deficiencies noted by number at bottom of page refer to index on other side and enclosed sheet.

Fill Out Below When Deficiencies Are Corrected and Mail Entire Sheet to Underwriters' Equitable Rating Bureau

CERTIFICATE OF CORRECTION

191

This is to certify that the defects referred to above have been corrected as follows:

(Signature)

NOTE—This certificate must be signed by some official of the Electric Light Company, Contractor doing the work, or City Electrical Inspector, before being accepted, and is accepted only pending re-inspection by the regular Electrical Inspector of the Bureau.

DEFECTS:

Enclosed with this sheet is Exhibit "B" a printed list of defects. This is a perpetual list, as the decimal idea of indexing is followed. When a defect gets a number it will always have this number. New defects can be added under any heading by adding a new number, and defect. This makes this list applicable to any town and all towns.

It is well to add here that when the inspector is doing the actual work in the field he uses only an ordinary stenographer's note book for his notes. When in the office he places it under the office number system. In the field the numbers are too hard to handle.

When these new defects are added they do not appear on the printed list immediately, but are written out with the proper number on the back of the sheet, Exhibit "A," and in time will be added to the printed sheet.

Exhibit "C" shows form of letter used to notify owners and tenants when we have readjusted their insurance rate.

Exhibit "D" is a letter we issue when we find defects have been corrected to our satisfaction.

Exhibit "E" is the office sheet for our records, which contains the whole history of the inspection as regards any particular risk.

Exhibit "F" shows printed reports as issued on cities and towns after the first reinspection. These are for our use only—not under any circumstances given to the electrical contractors.

Instead of the old 25 per cent increase for defective wiring, whether consisting of minor defects or in a very hazardous condition, we have revised our charge and try to use judgment in making the following graded charges as an increase to the rate: Fair, 5 per cent; poor, 10 per cent; hazardous, 15 per cent; very hazardous, 15 per cent; trolley current, 25 cents; defective moving picture booth installations, flat charge of $1; up in bricks and in frame buildings, $1.50 to $2.50.

To also carry out a system of inspection and get the best results, we must have an intelligent body of contractors. In so many cases contractors take our notices and correct a defective installation, as they think is proper, but make as

EXHIBIT "B."

JAMES N. MCCUNE SECRETARY
P. O. BOX 743

TELEPHONES MAIN 136
A 4287

UNDERWRITERS' EQUITABLE RATING BUREAU
559 SHERLOCK BUILDING
PORTLAND, OREGON

INDEX OF DEFICIENCIES

ADJUSTERS:
1. Unapproved cord adjusters.

ATTICS:
10. Attics not properly bored and bushed.

BOXES:
20. Lids not placed on outlet boxes.
21. Outlet boxes loose.

CONDUIT:
30. Approved rigid or flexible conduit not used.
31. Conduit not locked to cabinet (a) or fittings.
32. Conduit not properly grounded.
33. Condulets off of conduit.
34. Service conduit must extend to main line cutout or into cabinet if same is required.

CORDS:
50. Flexible cord not standard.
51. Flexible cords too long (a) or used other than as pendants.
52. Flexible cords in show windows.
53. Lamp cords in bad shape (a) or hung on metal hooks, nails or grounded materials (b) or run through partitions.
54. Pendant cords ornamented with tissue paper or gauze.
55. Portable lamps, motors, fans or fixtures not connected through re-inforced cord.
56. More than one cord in a rosette.
57. Pendant cords without knots in fittings.
58. Pendant cord attached to circuits without approved fittings.
59. Unapproved cord adjusters.
60. Cord circuits.
61. For pendant cords in wet or dusty places use stranded brewery cord or packing house cord soldered direct to circuits but supported independently, also weather-proof sockets must be used.
62. More than one light on pendant cord without approved fittings.

CLEATS:
100. Three-wire cleats are prohibited.
101. Wires attached with wood cleats, staples or nails.
102. Cleats should not be concealed.

CABINETS:
110. Cabinets not properly made (a) or lined.
111. No doors on cabinets.
112. Cabinet doors not lined.
113. Wooden cabinets used with iron conduit.

CIRCUITS:
120. Circuits overloaded.
121. Circuits overfused.

FITTINGS:
130. Broken fittings.
131. Loose fittings.

FUSES:
140. Unapproved (a) or improper use of open link fuse blocks.
141. Too many lights dependent on final fuse block.
142. Cartridge fuse block bridged with string fuse or wire.
143. Improper fuse block (a) or none at entrance.
144. Arc lamps not fused individually.
145. Fuse blocks located over or near inflammable material.
146. 125-volt fuses on 220-volt circuits.
146. Fuses too large to protect circuit.
147. Refilled (a) or reinforced fuses.

FLEXIBLE TUBING:
170. Flexible tubing too short at outlets.
171. Flexible tubing used through floors or in damp places.
172. Service wire bushed with flexible tubing; must be porcelain or conduit.
173. Every wire nearer than 5 inches apart must be encased in a continuous piece of flexible tubing.

FEEDERS:
200. Feeders overloaded.

INDEX OF DEFICIENCIES—Cont'd

FIXTURES:
210. Electric fixtures not properly installed.
211. Fixture canopies on top of circuit wires or pendant switch wires.
212. Not properly insulated.

FOOTLIGHTS:
220. Footlights not standard and in a hazardous condition.

HAZARDOUS:
230. Installation in such a hazardous condition, that same should be completely re-wired.

INSULATORS:
240. Improper canopy insulator or none preventing contact between canopy and steel ceiling, gas pipe or grounded surfaces.
241. Cross-over tubes or insulators not properly fastened in place.
242. Insulating-joints should be used where fixtures could otherwise become grounded.

JOINTS:
260. Joints not soldered, (a) or taped, (b) or properly made.
261. No rubber tape on joints.

LAMPS:
270. Lamps hanging against woodwork.
271. Open arc lamp inside of building.

LOOSE:
290. Bad or loose connections at fuse blocks and switches.
291. Switches loose.
292. Fittings loose from support.
293. No support provided for fittings.

LUGS:
300. No terminal lugs used.

MOULDING:
310. Moulding not properly made (a) or painted, (b) or used in damp places.
311. Moulding without capping.
312. Moulding run on grounded surfaces without backing.
313. Soft wood moulding used instead of hard wood moulding.
314. Moulding installed without taplets.

MOTORS:
330. Motor overfused.
331. Motor should be enclosed.

OUTLETS:
340. Outlets not in use should be thoroughly taped up.

PROTECTORS:
350. No protector (a) or improper protector at entrance on telephone or signal wires, (b) or protector improperly located.

RECEPTACLES:
360. Lamp receptacles with exposed lugs or contacts in show window.
361. No sub-base under snap switch (a) or receptacles.
362. Unapproved receptacles.

ROSETTES:
370. Unapproved rosettes.

RHEOSTATS:
380. Rheostat not properly mounted.

SWITCHES:
390. Improper switch (a) or none on fan or motor circuit.
391. Improper switch (a) or none at entrance point.
392. Entrance switch improperly located (a) or not readily accessible.
393. Entrance switch (a) or fuse on house side of meter.
394. Knife switch inverted (a) or located on line side of entrance fuse.
395. 120-volt switch on 220-volt circuit.
396. No sub-base under snap switch (a) or receptacles.
397. Switch and cutout must be placed in approved cabinet.
398. Main service switch and fuse too far from the entrance of service wires to building.

INDEX OF DEFICIENCIES—Cont'd

399. Motor switch and cutout must be placed in cabinet.

SIGNS:
420. Electric signs not constructed and installed according to National Electrical Code.

SOCKETS:
430. Lamp sockets not bushed.
431. ¾-inch sockets used on re-inforced cord instead of ⅝-inch sockets.

SWITCH BOARDS:
440. Not constructed in skeleton form of hard wood, slate, marble or approved composition.
441. No approved ground detector.

TROLLEY CURRENT:
450. Current for motor (a) or lights taken from trolley current.

THEATERS AND MOVING PICTURE ESTABLISHMENTS:
460. Not installed in approved conduit.
461. Footlights, borders or strips not constructed according to National Electrical Code.

TRANSFORMERS:
480. Bell ringing transformers not properly mounted (a) or not of approved make.
482. Sign transformer not properly mounted (a) or not of approved make.

WIRE:
490. Wires of opposite polarity in contact (a) or too close together.
491. Service discontinued, but live wires still attached to building.
492. Wires not bushed at entrance.
493. Wires against or too close to grounded pipes or improperly protected.
494. Wires not protected where liable to mechanical injury.
495. Wires in contact with outside awning (a) or with metal front or side of building.
496. Telephone or signal wires in contact with (a) or too close to light or power wires.
497. Wires not bushed (a) or bushed improperly through walls, floor or partitions.
498. Wires of opposite polarity through one hole.
499. Wires too small for current carried.
500. Wires not attached rigidly in position (a) or loose from support.
501. Other than rubber covered wire used for concealed work.
502. Wires not properly separated in concealed work.
503. Wires not supported at sufficiently frequent intervals.
504. Solid wires used as conductors to swinging or movable lamps.
505. Wires not entering conduit properly at change from knob and tube to conduit work.
506. No fuse used where change is made in size of wire.
507. Service wires in bad shape or not properly attached to or insulated from building.
508. Wires in contact with other materials than insulators.
509. Unapproved wire.
510. Porcelain supports for wires fastened to grounded surfaces.
511. Overfused wire.
512. Wires not properly supported over route.
513. Wires and open work not properly guarded.
514. Wires held in place by tie wires on sizes smaller than No. 8 B. & S. gage.
515. Bare wire.
516. Wires knobbed (a) or cleated over flat surfaces.
517. Dead circuits and wires should be removed.
518. Cleated (a) or knobbed over grounded surfaces.

WIRELESS TELEGRAPH:
600. Not properly installed according to requirements of National Electrical Code.

NOTE—Example to illustrate use of above: Given defect "490." This should be read "Wires of opposite polarity in contact." Had given defect been "490a" this should then be read, "Wires of opposite polarity too close together."

many violations of the code as the original notice pointed out.

These errors come principally from ignorance of the rules and requirements. It is very discouraging when we realize what a small percentage of the electrical contractors read the N. E. C. intelligently. So many are still bound by the old traditional prejudice against the code and are contented to say it is "indefinite," "contradicts itself," and so "poorly indexed" that nothing can be found.

When the electrical contractor will spend a few hours of his valuable time trying to consistently understand the N. E. C. be will have no trouble, but if he allows it to lie in a dusty corner and hurriedly grabs it and thinks all the information will jump out when he presses the button, he will be sadly mistaken.

If after making an effort to understand the code he should fail to understand some point in regard to inspection and correction of defects, we always stand ready to give all the help and advice at our command. All that is necessary is for any one in doubt to call in person at our office or put their troubles in writing, and we will do everything in our power to give them a clear understanding of our desires in the matter.

We always wish to foster local inspections in the various cities, and have a standard electrical ordinance outline which can be adapted to the local needs of any community. These can be obtained upon application at our office.

To always keep the contractor advised, we send out electrical circular letters, such as Exhibit "G." These deal with local rulings and changes in the N. E. C. Annually we publish an addenda to the N. E. C., which is a summary of all changes, rulings, etc., to date. The circulation of all literature is limited to our mailing list, and any one interested should be sure their name appears there.

So far it all looks lovely, hut now what influence does the local electrical contractor have on this system, outside the matter of correcting the defects themselves. Sometimes very

EXHIBIT "C."

On ....you were notified of defects in electrical installation in your property, ..., which under certain circumstances may lead to fire, and were requested to notify us of their correction. Sufficient time having elapsed and the defects still existing, it will be necessary to readjust the rate at once to meet this hazard.

Subsequent readjustment will be made on receipt of a "Certificate of Correction" signed by the City Electrical Inspector—or in absence of this official, by some official of the electric light company, or contractor doing the work—that the installation has been made to conform to the rules and requirements of the National Electrical Code.

Yours truly,

little, and again he can make it appear in a light which causes endless strife.

First—He is a resident of the community in which he has his place of business, has friends and more or less influence with the rest of the citizens, and if he is willing to do missionary work and tell owners and tenants why we require changes, and that our only purpose is to reduce the fire hazard and produce safe conditions, instead of saying we are robbers and own stock in the great supply business and desire changes only to make business for the sale of materials and fittings, he will make the system a great deal more efficient, also impress upon everybody that the electrical business is governed

EXHIBIT "D."

This is to certify that the electrical defects as pointed out in our notice of..................in regard to property located .... have been corrected in a satisfactory manner.

by a National Code of undisputed authority, and is not a haphazard business, dependent upon any one man's "hobby."

Second—The electrical contractor may be a competent contractor, and understand his business, or he may be a careless workman and not understand code rules and requirements.

EXHIBIT "E."

No.________ Form 1

TOWN OF________________

NUMBERS REFER TO SANBORN MAP 1______ Inspected________________191__

NAME OF OWNER OR PERSON TO NOTIFY	SHEET / R	BLOCK / PAGE	SANBORN MAP NO	STREET AND NUMBER	DEFECTS
				(Refer to Index of Deficiencies)	

REINSPECTED		NOTIFIED			LETTERS AND INQUIRIES			CERTIFICATE		RATES ADJUSTED	
DATE	BY WHOM	DATE	WHOM	FORM	DATE RECEIVED	FROM WHOM RECEIVED	DATE ANSWERED	DATE	SIGNED BY	DATE	HOW

Third—He may be honest and try to do the best he knows how, or he may run a "skin game" in all his dealings.

Fourth—He may be content with legitimate profits, or he may be exorbitant in his charges.

Fifth—He may be willing to put in all new work, according to the rules and requirements of N. E. C., or he may not.

Therefore you see honesty in its broadest sense and cooperation is what we desire from the electrical contractor in

EXHIBIT "F."

UNDERWRITER'S EQUITABLE RATING BUREAU.

Electrical Report.

Original Inspection June 3 to 9, 1912.
Re-inspection October 23 to 26, 1912.

The .... supplies electric energy to .... Current is transmitted at 23,000 volts and stepped down within the city limits to 2200 volts, at which pressure it is distributed by a common circuit to both light and small motor users. A separate power circuit is provided for large motors, and this includes the .... at 220 volts and the city pumping plant at 2200 volts.

All service transformers for lighting are 2200-110 volt. Those for power are 2200-220-110 volt. All neutrals are grounded.

At substation three 250 kw. water-cooled transformers are in delta connection. These are 23,000-2300 volt.

The company maintains two arc circuits, one for business streets and one for residence streets. Sixty-three series arcs are used and these are about equally divided between the two circuits. Voltage of arc circuits, between 2500 and 3000 volts.

The Fire Marshal has authority to make electrical inspections, but no real inspection of the city has ever been instituted in the past, for the reason that the Fire Marshal is the only electrical contractor in the city.

The Western Union Telegraph Company maintains a 21 clock, 65 volt circuit energized from gravity cells.

All telephone entrances to buildings are protected by Pacific Telegraph and Telephone Company's standard arrester.

Oregon, to aid us in making our system of inspection a complete success.

The feeling of antagonism against the bureau should pass away with a clear understanding of our methods and ideals and be replaced by a true loyalty on the part of every

"G."

ELECTRICAL CIRCULAR NO. 40.

To Electrical Contractors, Wire Manufacturers, Jobbers and the Electrical Trade in general:

Rubber-Covered Wire.

Gentlemen:

Referring to our previous Electrical Circulars Nos. 36, 37 and 39, on rubber-covered wire, flexible cord and armored cables, we beg to advise that after January 1, 1913, this Bureau will not sanction the installation of any of these products—under any conditions—unless same conform to the 1911 "N. E. C." specifications and have the proper "Underwriters' Laboratories" label attached.

Yours truly,

UNDERWRITERS' EQUITABLE RATING BUREAU,
F. D. Weber, Electrical Inspector.

electrical contractor—as we are the very life and essence of his business—and are trying to be absolutely square to him. We desire a "square deal" and also desire the owners and the contractor to get the same.

(To be continued.)

INDUSTRIAL

INDESTRUCTIBLE SQUIRREL CAGE ROTORS FOR INDUCTION MOTORS.

The squirrel cage induction motor has long been recognized as the most substantial and reliable of any class of power apparatus. However, there has always been one detail of construction that has caused more or less trouble even in the best of designs.

This detail is the joint between the rotor bars and the end rings. These joints, of which there are two to each bar, have to carry low voltage currents of great volume, especially while starting, and consequently anything less than perfection at this point becomes the occasion of extreme local heating, sometimes followed by the ultimate rupture of the joint, and perhaps such arcing and burning of the bars and end rings as to necessitate expensive repairs.

Various forms of screwed joints, riveted joints and soldered joints have been employed with more or less success, but it has been known by engineers that so long as there was any joint at all between the bars and the rings, there were just so many points of possible failure under operating conditions of extreme severity, and there has been no jointed rotor construction which has not proved this by showing more or less failures at this point.

The solution of the indestructible rotor problem, then, means a rotor without joints, and this has been accomplished in the cast-on end ring construction recently devised by the engineers of Fairbanks, Morse & Co., which is shown in the accompanying illustrations.

Casting Rotor End Rings at Electrical Factory of Fairbanks, Morse & Co.

The illustration shows the operation of casting so clearly that little explanation is required. The rotor bars are assembled in the core, and the end rings of either brass or copper are cast around the ends of the bars. The treatment of the bars and the process used being such that a perfect fusion of each and every bar with the metal of the end ring is secured, and a "cage" produced as solid and indestructible as if it were made in one piece. At the left of the picture the operation of casting the first ring on a rotor will be clearly seen, and at the right of the picture are two rotors upon which the first ring has been cast and the moulds prepared for casting the second ring. This illustration shows in a striking manner the fact that rotors thus prepared will hardly be subject to injury from any degree of heating that they will ever be subjected to in subsequent service.

After casting, the rings are finished and a deep groove cut into each ring down to the union of the bars and the rings, so that the integrity of each weld can be inspected.

TRADE NOTES.

The Pacific States Electric Company announce their occupancy of the new home recently erected for them at Nos. 575-77-79 Mission street. The new plant is a model supply house in every detail; the ground floor being devoted to sale and display room, while the upper ones are occupied as offices and store rooms.

NEW CATALOGUES.

The Crocker-Wheeler Company of Ampere, N. J., is distributing two new bulletins, Nos. 150 and 158. The former deals with coupled and belt types of alternating current generators, while the latter describes adjustable speed motors.

The Westinghouse Electric & Manufacturing Company are distributing a number of attractive catalogues, leaflets and folders. No. 1203 is a very handsome catalogue on the Westinghouse Electric Ignition and Lighting System and other accessories for gasoline automobiles. Descriptive Leaflet 2441-A gives instructions on the operating characteristics, mounting and method of drive of a.c. and d.c. motors. Leaflet No. 2485 is devoted to the application and operation of low-pressure steam turbines. Folder 4231 covers the application of Westinghouse motors to various services. Folder 4241 illustrates and describes Types C and OA Watthour Meters. Folder 4320 is concerned with polishing and grinding motors. Textile Quarterly No. 2 is devoted to motor drive in worsted and woolen mills.

BOOK REVIEWS.

Alternating Current Machinery. By William Esty, S. B., M. A. Size 7½x9½ in.; 467 pages; 409 illustrations; cloth binding. Published by the American School of Correspondence, and for sale at the Technical Book Shop, 106 Rialto building. Price, $3.00.

This book is a practical treatise on alternating current principles and systems, commercial types of alternators, synchronous motors, transformers, converters, induction motors, switchboard and station appliances. The author is well known in electrical engineering circles. As professor of electrical engineering at Lehigh University and author of a text-book on electrical engineering which has gained wide usage in American technical schools, he needs no further introduction. Alternating current phenomena is difficult of elucidation at best. In this book, however, the reader is taken over the road in easy, simple stages, by a path devoid of difficult mathematics. For the student endeavoring to master the fundamentals of alternating current machinery and phenomena, and who must travel the road alone, the book is strongly recommended.

Primary Battery Ignition. By C. Wadsworth, Jr. Size 5x7½ in.; 78 pages; 26 illustrations; cloth binding. Published by D. Van Nostrand Company of New York, and for sale by the Technical Book Shop, 106 Rialto building, San Francisco. Price, 50 cents.

This booklet is a simple, practical pocket guide on the construction, operation, maintenance, and testing of primary batteries for automobile, motorboat and stationary engine ignition service. Automobile fiends and the layman who has at times the operation of primary batteries will find the book most useful and helpful.

NEWS NOTES

INCORPORATIONS.

HELENA, MONT.—Articles of incorporation have been filed of the Montana Eastern Railway Company, which is to to construct a line out of Lewiston to the east to meet the main line of the Great Northern at New Rockford, N. D. The company is capitalized at $10,000,000. Head offices will be established at Lewiston.

VANCOUVER, WASH.—The Northwestern Electric Company has filed a declaration of intention to do business with capital stock of $10,000,000. It proposes to generate, transmit and furnish electricity for heat, light and power and operate railroads, lumber mills, mercantile establishments and telephone and telegraph lines. H. A. Mitchell is president and Chas. Barnard of Portland is general agent.

ILLUMINATION.

MONTESANO, WASH.—A franchise has been granted the Elma Electric Company over the county roads to the town of Satsop.

CHINO, CAL.—The Southern California Edison Company has been granted a gas franchise. According to present plans work on laying pipes will begin about January 15.

GRANTS PASS, ORE.—The "Jimmie Quinn" ditch at Takilma has been purchased by C. E. Phillips and Elmer Dunn, who will put in an electric plant.

LOS ANGELES, CAL.—The Southern California Edison Company has filed an application for a franchise to lay gas mains in the streets of Wilmington and San Pedro.

KENNEWICK, WASH.—The contract has been let by the Pacific Power & Light Company for the construction of a large warehouse on property adjoining its present location.

BEAUMONT, CAL.—Representatives of the Southern Calfornia Edison Company of Redlands, state that they expect to apply for a franchise to market electricity in Beaumont as soon as the new city government is instituted.

SANTA ANA, CAL.—Bids will be received up to January 6th for the franchise applied for by the Southern Counties Gas Company for laying a system of gas pipes in certain portions of the city, for the purpose of conducting commercial gas for lighting, heating and fuel, for a period of 25 years; said franchise to be awarded to the highest bidder.

STOCKTON, CAL.—The Oro Electric Corporation, which is preparing to enter San Joaquin county to supply electric current for power and lighting, has filed an application with the Supervisors for a blanket franchise for a pole line in this county. The Supervisors advertised the same for sale, bids to be received January 7 next at 10 a. m. The franchise sought is to enable the Oro company to supply current to farmers in various parts of the county. Attorney C. L. Neumiller represented the applicant.

SACRAMENTO, CAL.—City Commissioner Wilder has announced new specifications for street and other city lighting which provide distinctive innovations in the call for sealed proposals to be published by direction of the city purchasing agent at once. The first bid is for incandescent lamps for various city buildings and public works, each location to be considered separately. Another bid will be for current for motors in the city wharf, city library and the city hall. For electroliers the bid will be for 110 volt current to be supplied to 500 electroliers of 250 watt capacity each, wired eight to a circuit. The next bid in the order in which they come in the specifications will be for providing the plant or equipment for street lighting. Next is for supplying power for the street arc lamps. It is proposed by the city to install electrically driven pumps for the city water works and in case such is done, bids will be considered on current for regular consumption. The Pacific Gas & Electric Company now holds the contract for furnishing electrical energy to the city, the contract to expire the first of next year. For the big 3000 candlepower street lamps the city pays $6 each month for each lamp, and there are more than 700 lamps in the city. The total amount paid to the Pacific Gas & Electric Company this year for lighting will be more than $60,000.

TRANSMISSION.

NANAIMO, B. C.—The Nanaimo Electric Light, Power & Heating Company, Ltd., plan extensive alterations and improvements to the plant.

NEW PLYMOUTH, IDAHO.—The Idaho-Oregon Light & Power Company expects to build several miles of line out of this city to farms in this district.

BOISE, IDAHO.—The Southern Idaho Light & Power Company and the Idaho Traction Company plan on making numerous improvements in this city.

NEW WESTMINSTER, B. C.—The Western Canada Power Company has secured a contract for supplying power to the D. factory of the Dominion Match factory and to the British Columbia Transport Company, Sapperton.

COQUITLAM, B. C.—The British Columbia Electric Company has secured the contract for supplying light and power to the C. P. Railway Company's roundhouse here and will shortly begin work of erecting a pole line to the property of the concern.

KAMLOOPS, B. C.—Du Cane, Dutcher & Company, Rogers building, Vancouver, B. C., announce bids will be received until December 19 for furnishing steam pumping and electrical equipment for the municipal power plant here, instead of December 5.

HELENA, MONT.—The legislature will be asked to appropriate $300,000 for completion of the state's hydroelectric plant at the racetrack between Warm Springs and Deer Lodge, the power generated to be used at the state prison, asylum and tuberculosis hospital.

CENTRALIA, WASH.—The Washington-Oregon Corporation will build a power line on the west side of Cowlitz River, between Kelso and Castle Rock, giving the town of Lexington electric current for light and power purposes. The line will also be extended across the river to Ostrander.

ASHTON, IDAHO.—According to well authenticated reports former U. S. Senator W. A. Clarke of Montana, recently purchased a power site near here on the north fork of Snake River and will expend three-quarters of a million dollars in constructing a power plant and stringing transmission lines into Montana and Idaho. Work will begin in the spring.

TRANSPORTATION.

LOS ANGELES, CAL.—Emmet H. Wilson has applied for a franchise to construct a street railway line on Vernon avenue, from Dalton avenue, to the west city limits.

SAN FRANCISCO, CAL.—As the franchise of the Presidio & Ferries Railway will expire December 30, 1913, the Super-

visors, on motion of Supervisor Koshland, have taken preliminary steps leading toward municipal ownership of the road. A resolution was adopted requesting the city attorney to report to the board a plan of procedure, including an opinion as to what rights the city may have in the roadbed. The city attorney also will outline the procedure necessary for the city to acquire the rolling stock and other physical property.

OROVILLE, CAL.—A loss of $13,000 to $15,000 was caused by a fire which destroyed the Northern Electric Company's depot here. The building loss is $4000. Defective wiring caused the blaze.

MONTEREY, CAL.—The Monterey & Pacific Grove Electric Railway Company has been granted a franchise on its bid of 1 per cent of its gross receipts annually for the first five years, and 2 per cent annually thereafter.

EL PASO, TEX.—A franchise for an electric railroad from El Paso down Rio Grande Valley to Ysleta, and deeds to rights of way are now in possession of Stone & Webster of Boston, and that corporation's representatives in El Paso are already busy with preliminaries with a view to begin construction of the road.

SAN FRANCISCO, CAL.—Notices have been sent to the stockholders of the Sacramento Valley Electric Railroad Company calling a special meeting to be held in the executive offices of the company at San Francisco on Saturday, December 14, for the purpose of increasing the number of directors from five to seven. This action will be taken in order to make it possible for Solano county to have sufficient representation on the board of directors. The people of Solano contributed to the fund with which the survey was made through that county for the connection of the electric road from Woodland to a point below Dixon, where it will join the Oakland, Antioch & Eastern.

OAKLAND, CAL.—Alleging that the Oakland, Antioch & Eastern Railway is being built for the ultimate purpose of becoming the western terminus of a new transcontinental railroad, and that the traffic over such road would render Shafter avenue useless for residence purposes, H. P. Fry, Helen K. Fry and Fred W. Fry have filed suit against the corporation for $3800 damages to their property on that street and for an injunction restraining the defendant from operating trains over the tracks. A similar suit was filed by Blanche H. Cary, who asks $1000 damages. In regard to the suits President W. Arnstein of the Oakland, Antioch & Eastern, said: "Our franchise forbids the operation of steam trains. All the talk about a transcontinental road backing us is ridiculous."

RICHMOND, CAL.—Illumination of the business streets over which its new interurban electric lines will run, a 5c fare within the city limits, the designation of stations by the city and the payment of 2 per cent of the gross annual income of the road to the city at the expiration of five years, with the city to have the right of examination of the company's books to determine same, are the principal features of the revised draft of the franchise asked for some time ago by the Southern Pacific Company and last week accepted by the company at a meeting of the city council. The new franchise provides that the company may do freight hauling between the hours of 10 p. m. and 6 a. m., but provides that no freight cars can be left standing on any of the streets. Passenger traffic over the first division will commence early in the spring.

VALLEJO, CAL.—A case of interest to railway officials was decided by the Railway Commission, when it granted permission to the Vallejo & Northern, the Northern Electric's newly acquired subsidiary, to discontinue its passenger train service until the entire line is opened from here to Sacramento. The commission held that the earnings of the carrier on those portions of its line already completed are not sufficient to warrant operation. The decision is regarded as important because hitherto the railroads have followed a policy of establishing train service along their projected lines as rapidly as possible, operating trains over every mile of available track as the road became available. The commission's decision, however, is regarded as a sanction of the withholding of service until the entire line, as projected, is completed. The decision will have an effect on numerous towns in the State, which are situated on projected lines and which have expected the respective lines to be opened to train service as soon as possible. The Northern Electric's specific request was that it be allowed to discontinue service between Boynton and Armijo, and from a point on the Vallejo & Northern near Fairfield to Fairfield Junction.

OAKLAND, CAL.—Work is being rushed on the new East Oakland extension of the Oakland Traction Company's lines along East Sixteenth street and the Foothill boulevard. It was announced by the engineer that the line probably would be in operation within three weeks. The extension will mean the laying of 17,000 feet of double track at a cost of $172,500. It was necessitated by the rapid increase in population of the district through which it will pass and the great need for removing traffic as much as possible from East Fourteenth street, now the chief highway for nearly all traction cars of the East Oakland district. The new line begins at Thirteenth avenue and extends eastward on East Sixteenth street to Talcott avenue, to Twenty-fifth avenue, to the Foothill boulevard, to Courtland avenue, to Ignacio avenue, to Trask avenue. The recently completed extension of the Euclid line in Berkeley has been put into operation, supplying a car service to many districts in North Berkeley, Craigmont and Northbrae, which have hitherto been inaccessible. That the High street and East San Jose avenue line of the Oakland Traction Company in Alameda will be broad gauged by March 1 was promised at the meeting of the City Council by Assistant General Manager J. P. Potter of the street car company.

TELEPHONE AND TELEGRAPH.

METALINE FALLS, WASH.—The Bell Telephone Company has applied for a franchise throughout the county.

DAYTON, WASH.—The Patit Telephone Company has been organized and will operate about 50 miles of telephone lines.

PRESCOTT, ARIZ.—With the completion of the double tracking of the main line of the Santa Fe between Yavapai and Ash Fork, the Postal Telegraph Company will install telephone service between Seligman and this city.

CLE ELUM, WASH.—The Pacific Telephone & Telegraph Company has been granted the right to erect poles, wires and other appliances for the transmission of electricity for telephone and telegraph purposes in, upon and under the public highways of the city.

EUGENE, ORE.—A new telephone company has been organized under the name of The Lancaster Telephone Company No. 2. Hans Albertson has been elected president. The new line will be four miles in length and will run from Lancaster west to Naraton into Junction City.

ALPHABETICAL INDEX TO ADVERTISERS

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity, Power and Gas, Rialto Building, San Francisco.

FOR SALE.—One second-hand Weston D. C. ammeter, 0 to 50, in perfect operating condition; $10.00. J. E. McGillivray, Boise, Idaho.

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

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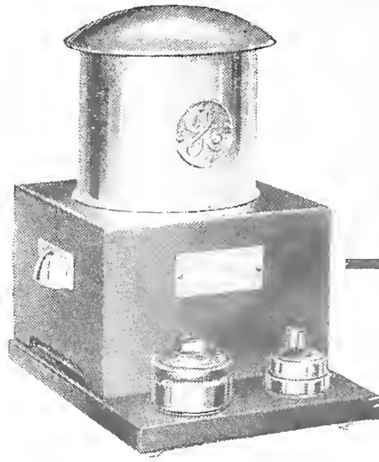
Where to Buy It in the West, Pages 9, 10.   Alphabetical Index to Advertisers, Page 8.



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JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXIX SAN FRANCISCO, DECEMBER 21, 1912 NUMBER 25

ILLUMINATION OF THE PANAMA-PACIFIC EXPOSITION

BY W. D'A. RYAN.[1]

I do not wish to give the impression that I am going to take up time with a technical discussion on light. I will, however, explain a few of the fundamental features in an elementary way; those things which have to do primarily with this Exposition lighting. In the first place, it raises the question, "What is light?" Light is a wave motion, as we understand it. The sun, for instance, sends out innumerable waves that travel through the ether, which fills all space. These waves travel at the speed of 182,582 miles per second, but they vibrate at various rates. Light, therefore, is a vibration. We can measure the rate of the vibration. There are many waves leaving the sun, and when a wave once starts, it goes on forever, unless it strikes something. As the ray strikes and re-radiates it produces the effect of color, or light.

Arc Lamp and Other Demonstrating Apparatus.

It is difficult to realize the enormous speed of light. The alternating current used for lighting is 60 cycles. The electricity leaves the mountains, passes through all the wires, through our lamps, our toasters, our flatirons, etc., and returns to the dynamo. This is done 132 times a second; you think this is rapid, but it is slow compared to the velocity of light. For instance, there are some stars so far away that if a ray of light left the earth at the beginning of the Christian era, it would not have reached them yet.

We will be able to show you in a few minutes how we can measure the velocity of stars. We have these light waves, and the longest rays coming from the sun are heat waves. They are too long to be seen. We start with a vibration of red, vibrating at the rate of 424,000,000 million times per second. The shortest is violet, vibrating at the rate of 728,000,000 million times a second. Green comes between the two, so that we have three waves with which we can produce all the colors of nature. The accepted theory is that all matter is in a constant state of vibration, or is ready to go into vibration.

Suppose I throw a spot of white light on a screen, and that I next pull that spot apart and show you all the colors it contains. Here is a little piece of ma-

[1]Illuminating Engineer, Panama-Pacific Exposition.

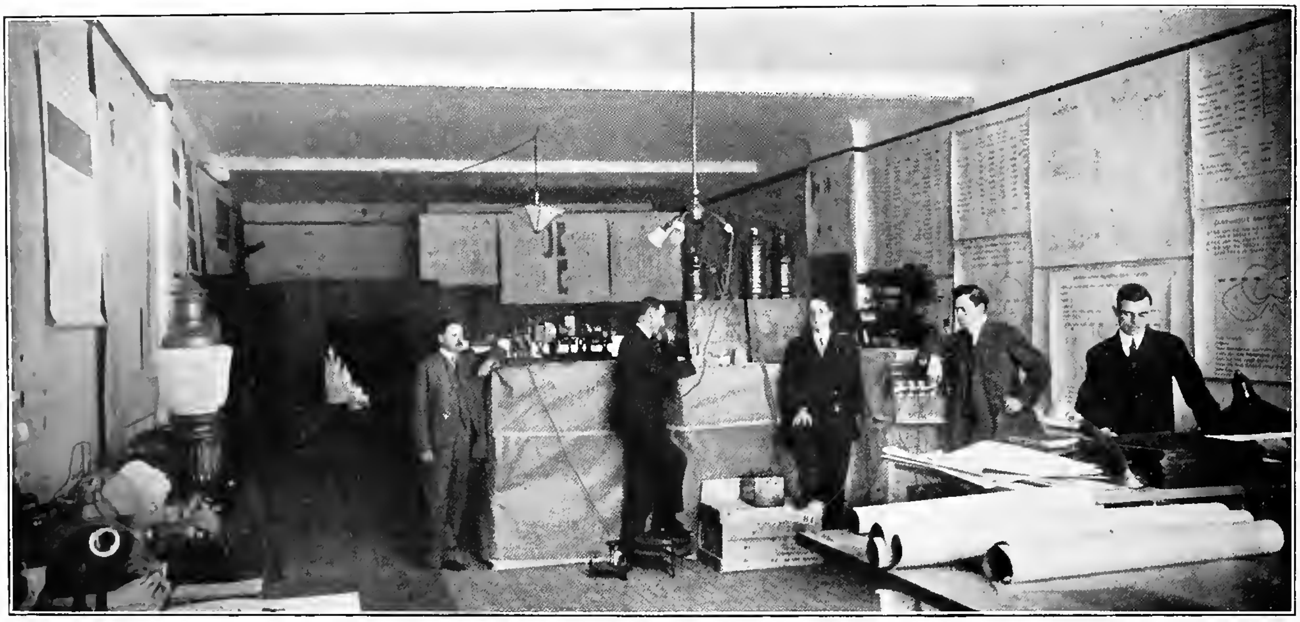
terial; that is red, because all the rays go into that material except the long, or red waves. If light did not contain long rays, there would be no sensation of red given back from it. You look; you say it is red. You receive that vibration precisely in the same way as though you struck a tuning fork near a piano; the wire in the piano whose note corresponds to the note of the tuning fork will vibrate when the fork is struck. The light strikes this and it sets up a vibration that corresponds to the vibration of red. I will put this in a light where there are no long rays, and it will be black. No object is colored in itself; it merely possesses the ability to radiate the rays as received from the sun.

I stated before that we had three fundamental waves; red, green and violet. If we have waves containing these different rays, we can produce every color in nature. Red and green make yellow; green and violet make blue; violet and red make purple. Now put light yellow and blue together, and you get white. An artist who works in pigments will not understand them. The reason is that an artist is dealing with an impurity in mixing his pigments. If we have a yellow pigment, a light containing all the rays falls into it, and they are all destroyed except the yellow and possibly some impure color. We take our yellow pigment, and we take our blue pigment; but we know that the yellow contains a little bit of green, the blue contains a little bit of green also. We mix the two pigments together, and the result is all you get is the impurity in both colors, which is green. Now we, on the other hand, are dealing in light, which is pure; therefore, when we mix yellow and blue we get white.

We take a beam of white light, and we will separate the colors. We will make the long rays go in one direction; the shorter the ray, the further out it will be spread from a certain definite point. Here we have a white beam of light spread out; here are your long waves, your intermediate and your short ones. If you place a white object in these lights, it will take the color of each light that falls upon it; if you put a black object in there, it will be black, no matter where you put it. If no wave lengths are sent back, it is black; if all are sent back, it is white.

The spectrum is crossed by little lines grouped in a certain way, and always grouped the same, so that from the spectrum we can tell exactly the composition of the planets and the velocity of the stars. Now if a star is traveling in the direction of the earth, this line will be pushed out of place; if the star is going way from the earth, it will be pushed in the other direction.

All these things have more or less bearing on our subject. I will show you a few interesting experiments with different colored lights. These lights are not lights colored up with any materials to make them look different; they are the actual lights used everywhere, for commercial purposes and in the homes.



W. D'A. Ryan and Assistants With Demonstrating Apparatus.

Here is the intensified arc lamp, which gives the nearest approach to daylight of any artificial light in commercial use. This will show the effect of gas; we could not get gas in here, and were obliged to use gasoline, which answers the purpose. This is the mercury arc; this is the Mazda, this is the Corrected Mazda, and here we have the ordinary carbon lamp, which is quite yellow. It has frequently happened in this case that the salesmen have told you that this is a white light; they call everything white when it comes out, but when you come right down to it you find it is quite decidedly on the yellow. The material is the same in every booth; it is the color of the light that makes them look different. Every object takes the color of the light which strikes it; it was no color in itself. We may produce a beautiful effect in flowers, but moonlight may kill the effect; so we much watch very carefully the balance of color.

Interesting experiments are easily devised showing the effects of the different lights on a red poinsettia, violets and carnations, showing that a flower will appear in its natural colors under one light, look black under another, and its color will be intensified under yet another. For instance, I may exhibit a few

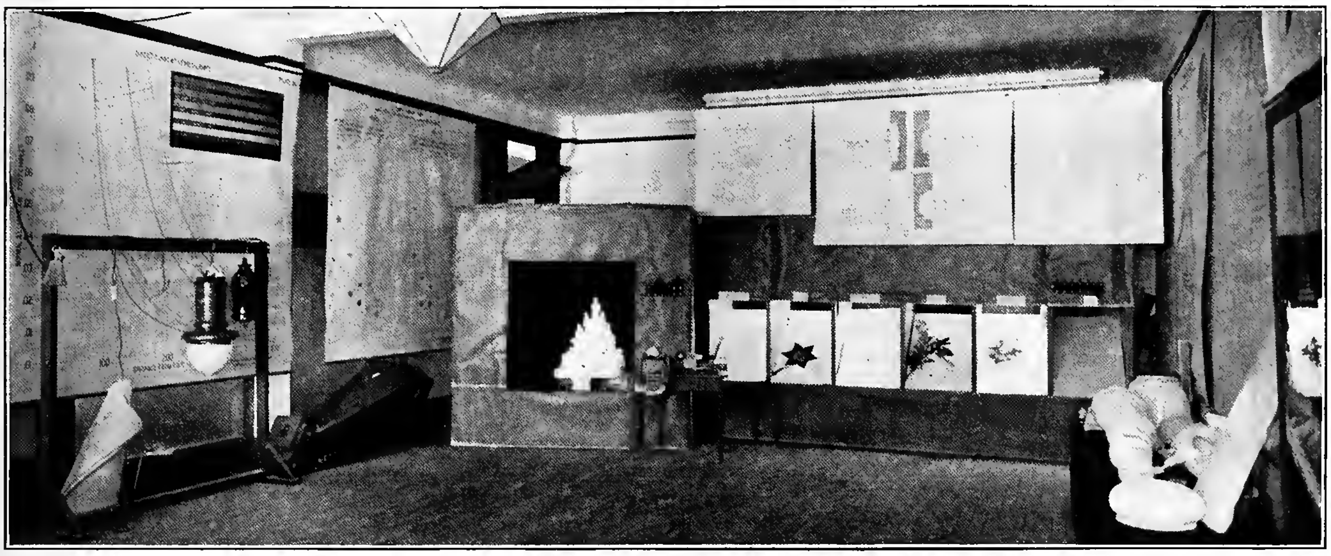
pieces of material under the different lights. These pieces of silk and wool are an absolutely perfect match; but I am going to show you how they would look if you purchased them under any of these lights. Under one light they will appear green and gray; in here you will get a different comibnation. Artificial lights are not all alike; some have too much green, some too much yellow. It is impossible to distinguish very pale green from white in a green light, or very pale yellow from white in a yellow light. (Showing a piece of plaid.) No matter what clan you belong to, you can take your plaid off this one piece. The white material is the one which tells the whole story. This is the way a piece of white material would look if you purchased it under any one of these lights.

I refer to these illustrations largely to show that we have lights of all colors, and we can use the ones

no glare, no dark places. This will be taken care of by means of indirect lights and concealed batteries. The method is a combination of direct and indirect illumination. Instead of outline lighting, we aim at a general illumination.

In place of incandescent lamps, we will use jewels where we want to emphasize. The jewels to be used for the Exposition vary in size from a marble to six inches. There is a vast difference between a glass doorknob and a scientifically cut jewel. This jewel is full of life; this is a poorly cut one, and we merely show it to illustrate the difference between jewels that are poorly cut and those that are scientifically cut.

They are cut for different distances and effects, and some are cut in this country and others abroad. They are just glass of a special cutting. It is rather strange to find that the glass cutters and jewelers had



Demonstrating Shadow Effects and Color Changes.

desired to maintain any particular color. For instance, the question of ground surface is interesting. We do not wish to produce too light a color in the concrete or whatever material is used. Most of the expositions have been pretty bright, and people go in tired and have headaches, and the worst light of all is the one that comes up from the ground.

As to the question of flags; we do not want to produce a light which destroys their effect. As to the question of wall surface; if you make that surface rough instead of flat, you will increase the effect of illumination at least 50 per cent.

Let me illustrate with straight and crooked lines drawn on a blackboard the effect of light on flat and rough wall surfaces. Now the light strikes this surface (flat) and it scatters in different directions, and a good deal of it will go up like that, and not be returned direct to the eye. That is particularly true if it is a shiny surface, which, I presume, it will not be. If it is a shiny surface, it will be almost impossible to get the light effect on it that you are looking for.

Our scheme of illumination will be entirely different from anything ever done before. The advance in electrical science within the last ten years will enable San Francisco to illuminate her fair buildings, inside and out, in an entirely new way. There will be

never cut anything in that size before, and it was entirely new to them. It was absolutely necessary for us to measure the index of refraction of the glass. This cutting is about right for 1000 yards, and here is one which is at its best at a distance of 2000 yards. Viewed from this side it looks like a piece of ice; from the other side it appears like a ring of light, which from a distance becomes a point.

These jewels cost no more than to operate incandescent lamps. In the sunlight they are dead; they will not be active. That does not mean that we will not get an occasional flash, but it will not be at all objectionable.

The Main Court will be surrounded by a row of figures 14 feet high, and the head of each figure will be crowned with a star measuring four feet across. These stars will be studded with jewels, which will pick up the light from the opposite side of the court and twinkle like diamonds. Lights will be played upon these jewels from masked batteries on the roofs of the buildings.

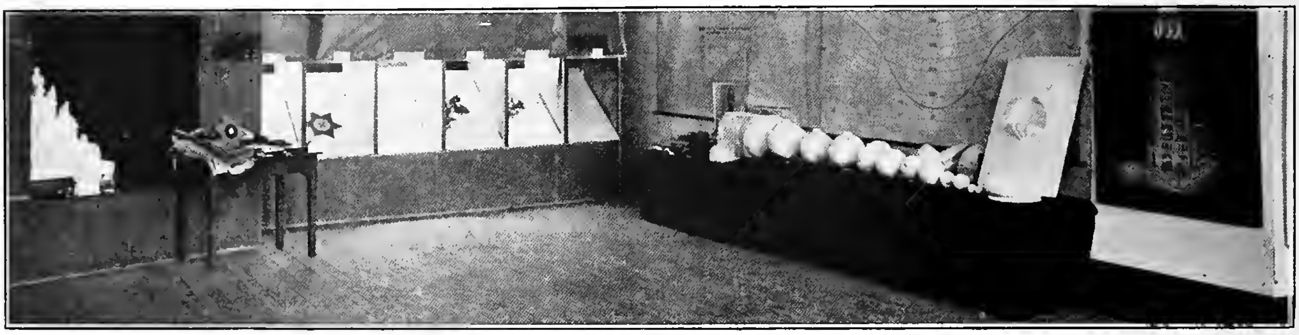
If we take a notion to change the color of some of these stones, it will not be at all difficult; we simply back the stone with the color which we desire. There is nothing so beautiful as a white stone, however.

For the Court of Jewels I have had some imitation

pearls made in Fostoria. You notice the different sizes; they can be strung according to size. It is a very good imitation, and the effect is as good as you can make. It is on the Tiffany order without the Tiffany prices. The light must strike them from the outside; the effect of lighting them from the inside would be to turn them a dirty yellow. Take a little soap bubble, and throw a light on the side of that bubble and show the iridescent colors such as you see in insects' wings. As the colors change you get all sorts of effects; one effect is like a Paisley shawl. I am working on a machine to blow bubbles by the thousand and throw lights on them, but it does not look very encouraging yet.

In the supplement to this issue of the Journal is found a reproduction of the proposed illumination at the Exposition. The method I propose is a combination of direct and indirect lighting, and not altogether concealed. The direct light will be the light on the facades, bringing out the color values in the proper relations, and the l'ght behind the columns will be a scintillator, which will be mounted off the main axis of the Exposition, about 500 or 600 yards out in the water. It will be placed on barges anchored in the bay, and will require sixty trained men to operate the lights. These men will be drilled, and the effect will be marvelous. They will go through an evolution of color, forming auroras and various effects in the sky and over the Exposition, and will spread like a great lily. This will be seen in all the surrounding bay cities, and on clear nights will be visible in the sky for 40 or 50 miles. We have a great deal of fog here, and this will assist us greatly in producing wonderful lighting effects. In fact, the fog is one of the greatest assets we could possibly have.

We are going to have a new method of turning on the lights. The first effect you will notice will be myriads of little jets of light; the next effect will be the light breaking out from behind the columns; and the next will be the main white light jumping out. Then over the whole Exposition will play the rays of the scintillator, going through over 300 evolutions in



Exhibits Showing Effect of Light and Color, Pearls to Be Used in Illuminating Plan.

warm yellow in the lower sections. The upper sections will be bluish purple, producing an artificial shadow in light. The stars on the heads of the figures will stand out, and over all will be the light from the

Power Data on International Expositions.

Exposition.	Area Enclosure in acres.	Total H.P. all purposes.	Total H.P. per acre Enclosure.	H.P. for Lighting.	H.P. for Lighting per acre.
Paris, 1889	173	5320	30.8	4000	23.1
Chicago, 1893	686	29830	43.5	11400	16.6
Paris, 1900	549	36085	65.7	13000	23 7
Buffalo, 1901	350	10000	28.6	1500	10.7
St. Louis, 1904	1240	44200	35.7	10000	8 1
Portland, 1905	400	12000	30.0	5400	13.5
Jamestown, 1907 ..	350	6680	19.1	5675	16.2
Seattle, 1909	250	13500	54.0	6700	26.8
San Francisco, 1915	625				
Average of all..	460	17846	36.5	6934	17.0

Lighting Data.

Exposition.	Incandescents.	Arcs.	Exposition.	Incandescents.	Arcs.
Louisville 1883	3998	No	Paris 1900	76720	
New Orleans 1884	3000	1500	Buffalo 1901	200000	
Paris 1889	9075	1053	St. Louis 1904	142000	2000
Chicago 1893	93040	3450	Portland 1905	100000	No
Nashville 1897	18382	458	Jamestown 1907	124497	70
Omaha 1898	21000	No	Seattle 1909	100000	No

Decorative Lighting Only.

Exposition—	Paris, 1889	Chicago, 1893	Paris, 1900	Buffalo, 1901	St. Louis 1904
KW. for lighting per acre of buildings	41.1	43.8	82.9	249	25

KW. for lighing per acres of buildings, average, 46.8.

colors. The effects will be wonderful in these fogs, which can be used as a background to change the whole color scheme and soften the tones. We can produce almost anything we wish.

We want to have a locomotive, probably one of the New York Central locomotives, mounted on a steel bridge which will revolve. It has light, power, motion and advancement; it will develop power sufficient to send it 80 miles an hour. As it throws off steam and smoke, lights from the scintillator will be flashed on these two mediums, producing a beautiful effect.

The standards will be magnificent groups of lamps. The main courts will be lighted by two fountains, and controlled so that the light can be turned up or down. By means of our system of lighting we will be able to produce perfect reflections of whole buildings in the lagoons, instead of mere patches of light.

There will be no outline lighting; wherever it is necessary to emphasize we will use the jewels. Outline lighting has been done so often that it has come to the point where people say: "If you see one exposition, you see them all; we want something new and beautiful." In many respects this Exposition will surpass all previous ones; in the arrangement of the buildings, in making the buildings colored instead of white, and in the system of illumination. In this Exposition there will not be a single piece of lighting that was ever used before; everything will be new.

The entire lighting is new in every respect, and it marks an epoch in illumination. The advance since the last big exposition in science and art of electric engineering and development of electric apparatus has been so great that we are now able to produce effects with economy which would have been physically impossible five or six years ago. In other words, the Exposition is to be a magnificent picture by night, with architectural splendor brought out to the best possible advantage in both form and color, maintaining the daylight perspective.

THE NEW AGRICULTURE.

The future of the West, aside from those advantages accruing from an intermediate location between European ports and the far east, must inevitably link itself with the productivity of its fertile soils. This future, indeed, spells the field of activity for the engineer in our Western Empire. The University of California, through its Board of Regents, has entered upon a proposed scheme of agricultural investigation and helpfulness never before undertaken in any place in the world. The California legislature will be asked this year to appropriate over a million dollars to forward this work. The very best brains the world has produced in this way of agricultural specialties will be engaged in this great work. Thomas F. Hunt has recently been installed as Dean of the Agricultural College at the State University to head this great movement. Below is an abstract of his speech at the recent dedication of the new two-hundred thousand dollar Agricultural Building at Berkeley.

If we take a hasty glance into the future we cannot fail to be impressed by the fact that the two great problems before California are to stabilize its water supply and humanize its labor supply. A few simple concrete illustrations may be better than much abstract discussion. In the Salt River Valley, Arizona, approximately ten million dollars have been expended, including the great Roosevelt Dam, to stabilize the water supply over 130,000 acres of already irrigated country and to bring 100,000 acres of the desert under the irrigation ditch. It was expected that this greatest reclamation enterprise in the United States would furnish about two dollars' worth of water per acre. In other words, a gross income per annum of about one-half a million dollars was anticipated. Although the enterprise has scarcely been completed in all its details, already it has contracts for one million dollars' worth of electric energy. It is said that there is nowhere any more livable region than in the foothills of the California mountains. Here can be developed unlimited power without the loss of any natural resource except the oil required to lubricate the machinery. In developing the power, the water in the valleys will be mobilized. When this is accomplished, California will have ten millions of people in place of two and a half millions. The slogan for California should not be one million persons for this or that city, depending upon which part of the State one is from, but two million families for California. Cover your hills and fill up your valleys with homes and the cities will take care of themselves.

California has rich river valleys whose conditions are like those which generations of Holland farmers have made famous. Canada has its agents in the lowlands inducing the Holland farmers to migrate to this northern country while our river valleys with their mild climate remain undeveloped. To develop this State with the least human sacrifice some selective process of locating people upon the land is needed. It is said that the farmers in the countries bordering upon the Mediterranean Sea are now saving their money against the time of the opening of the Panama Canal. When the thrifty Mediterranean folk come to our shore it will be the first time in the history of the world that these races have migrated to a country which was similar in its possibilities to their own. To entice these people upon land by means of "decoys" would be a social and economic crime. We need to study the history and adaptation of the peoples who now live in regions with natural conditions similar to our own. Instead of alluring the off scourings we should by some selective process secure the intelligent, thrifty, moral countrymen whose generations of experience will help to develop this country. When he arrives he should be located among natural conditions with which he has been familiar and protected until he has his industry upon its feet. It would be a form of protection that would protect. If you wish to compete with the peoples of the world you must develop in every locality that industry which naturally does best in that particular region, and you must put it in the hands of people who are most expert in that particular industry. By no other process can a state be developed to its highest efficiency.

The President and Board of Regents will be asked to establish a department in the College of Agriculture to be known as the Department of New Agricultural Industries. Already the United States Department of Agriculture and the State Experiment Stations have done splendid work in Plant Introduction. The introduction of a plant and the establishment of an industry upon that plant however are two widely different things. This department of New Agricultural Industries will not be a research nor a teaching department in the ordinary sense of the term. Its duty will be to study the agricultural industries of regions having conditions similar to California and to study our own state with reference to any industries which investigation may seem desirable to transplant. Last week we were told that Palestine is an exact counterpart of California except that Palestine is only one-tenth the size. Within this diminutive area, it duplicates the Sacramento and San Joaquin valleys, the valleys of the coast and the Sierra Nevadas and Coast Ranges. There is the same variation in climatic conditions and above all they have a four-thousand-year-old agriculture. No one knows what agricultural lessons this old world holds in store for us. Perhaps it may yet enable us to become the greater Palestine of a new civilization.

We have been discussing a century long program and a state-wide movement. Every man and woman in this audience will have been gathered in by Father Time long before our water supply has been fully stabilized and our labor supply fully humanized.

We are not now dealing with the individual, but with society. If society is not able to look beyond the confines of its individual members it is doomed to eternal damnation.

It may have occurred to some of you that the questions which have been discussed are beyond the realm of the institution which I for the moment represent. What has been said is for the purpose of emphasizing the fact that the University of California is perforce the leader of thought in all that relates to the welfare of the state and its College of Agriculture, if it is to be effective, must be the leader in all that relates to the development of agriculture. To fail to accept such leadership would be to fail to understand the responsibility that is placed upon it. Any other attitude upon the part of the people, whose child the institution is, would be reprehensible.

Unless the ranches of California are to be abandoned or are to be cultivated by foreigners, there are in California at this moment more than 8000 young men between the ages of 18 and 21 who will some day occupy the land. Less than six hundred are now receiving instruction in Agriculture in Berkeley and Davis. In a comparatively few years, a thousand students of agriculture will be enrolled at each place unless we do something to stop them. It should be determined at once what is the most efficient number that can be accommodated at Davis. It should be determined whether it is to be 300 or 600 or 1000. Plans should be made to start a new unit at Fresno as soon as the most efficient number that can be cared for at Davis is reached. At Fresno, where the university owns 5000 acres of land, there is an opportunity to build up the most extensive, most varied, and best instruction in horticulture, both for farm school and university, that is to be found in the world. No other such possibility exists anywhere. At Davis special emphasis should be placed upon dairying, animal husbandry and deciduous tree fruits. At Fresno, the emphasis should be placed upon grapes, citrus and other sub-tropical fruits and upon alfalfa and other forage crops. Instruction and investigations in cereals should be developed at both places. Under the conditions outlined a young man from Bakersfield or El Centro might go to Davis to receive instruction in animal husbandry and dairying, while the young man from Marysville might go to Fresno to specialize in horticultural subjects.

The tentative organization and scope of the College of Agriculture has been set forth with a good deal of tedious detail. I am frank to say that it has been done with a very definite purpose. The desire has been to make emphatic three points:

First—The College of Agriculture is located in California. Berkeley, Riverside, Whittier, Davis, Meloland and other places are merely points of operation. Los Angeles is the headquarters of the Santa Fe Railroad, but the Santa Fe Railroad is not located in Los Angeles. Last year the College of Agriculture met face to face 150,000 citizens of California.

Second—The work which is carried on at Berkeley, Whittier and Davis is not primarily for the development of the immediate localities, but is a part of a general scheme of education and research which looks toward promoting the general welfare of the commonwealth. The establishment of the Citrus Experiment Station is not primarily for the purpose of promoting the raising of oranges in Riverside County, but is for the purpose of studying problems which are of the greatest importance wherever agriculture exists under an irrigation ditch.

Third—Any additional points of operation which it may hereafter be deemed wise to establish must be considered from the standpoint of the general plan which has just been outlined and of the public welfare and not from the standpoint of local interest. I have faith that the people of California will rise to this high level.

The program which has been outlined is a large one. It is worthy of a great state. For its success it needs the help of every citizen. I believe it to be both logical and feasible. I asked for it the candid criticism of every person interested in the public welfare. With the assured and earnest support which this program has of the President and Board of Regents, I have faith to believe—and I am saying this in the most impersonal and detached way—that it must succeed.

I trust that President Wheeler was prophetic when he remarked several months ago: "I believe it will appeal to the people of California. They like to do a good thing."

PANAMA CANAL CONCESSION.

Probably one of the most interesting of the many great concessions that will be seen at the Panama-Pacific International Exposition is the production of the Panama Canal on a gigantic scale.

The concession will cost in the neighborhood of $250,000, and was granted to Lewis E. Myers, a well-known engineer of Chicago.

Mr. Myers is an engineer and not a showman. He visited the canal zone to study its construction and the idea came to him to perfect a means whereby the people of this country could learn more about it.

On his return to this country he proceeded to perfect and patent his ideas. He plans to truthfully reproduce the canal and the surrounding country in a weather-proof building, with a glass roof.

DECREASE IN NUMBER OF POLES PURCHASED.

While the total purchases of poles in 1911 was less than those for 1910 and 1909 by 452,674 and 320,720 respectively, it exceeded the totals for 1908 and 1907 by 168,866 and 134,752 respectively. The decrease in the 1911 totals as compared with that for the preceding year was confined entirely to a falling off in purchases by telephone and telegraph companies and steam railroads, while a substantial increase in purchases was made by electric railroads and electric light and power companies. The decrease in 1911 in purchases reported by the telephone and telegraph companies was not general, being confined in the main to states in which there was more than usual activity in the construction of telephone lines during 1910.

SCIENTIFIC PLANT MANAGEMENT

AN ANSWER TO CRITICISMS OF THE DIESEL ENGINE.

BY S. B. DAUGHERTY.[1]

A number of statements made in the article on page 384 in the issue of November 2, 1912, entitled "Recent Development of Diesel Engine Application," by J. W. White, Jr., leave in the mind of the reader an erroneous impression that will be harmful to a growing business and detrimental to the interests of power users in this country if they are allowed to pass unchallenged.

For the production of power by the combustion of fuel, no more efficient means has ever been devised than the Diesel engine, and if this engine is to take its proper place among prime movers in the United States it is essential that it be not charged with disabilities which are not inherent, and that the product of American manufacturers in this line be not condemned as wholly and irretrievably inferior to European built engines.

In the discussion of types, Mr. White outlines the relative advantages of the horizontal and vertical engines, but ends by saying that the single acting horizontal form is more liable to develop scoring of the cylinder walls and lubrication troubles, while these disadvantages would be absent in the same engine built vertically. Reference is undoubtedly made to the trunk piston type of engine.

But why build the horizontal trunk piston engine, when by increasing the weight and cost but slightly it can be made with a crosshead carried on an adjustable babbitted shoe, whereby the cylinder bore is left free to perform its proper function, and all of the connecting rod thrust and three-quarters of the weight is taken by the brosshead?

The magnitudes of these forces, when the ratio of the connecting rod length to the crank is as 5 to 1, are about as follows:

Weight of parts....................	6 lb. per sq. in. of piston area
Connecting rod thrust averages for the whole stroke...............	36 lb. per sq. in. of piston area
Total	42 lb. per sq. in. of piston area

In a trunk piston horizontal engine all of this comes on the side of the cylinder. For a piston seventeen inches diameter this average side pressure is about 9500 lb. In a vertical engine the side thrust due to the connecting rod is the same, and as it is six times that due to weight, the horizontal trunk piston engine carries only 16.6 per cent more side pressure than a vertical engine.

But with the horizontal crosshead type of engine all of this pressure excepting about 3½ per cent is transferred from the cylinder to the crosshead guide in the frame.

Among other advantages of the crosshead construction is that it is possible to make the wrist pin of a size more suitable for the load that it must carry. With a trunk piston it is not possible to make the wrist pin with a projected area of more than 25 per cent of the area of the piston. In most Diesel engines it is less. The result is that the nominal pressure on the pin per sq. in. of the projected area is four times the pressure in the cylinder or approximately 2000 lb. per sq. in. Its location within the piston where it is subjected to the heat radiated from the hot end of the piston is not conducive to satisfactory operation.

A specification of the Machinenfabrik Augsburg-Nuernberg A. G. giving the advantages of their horizontal engines over the vertical type of which they have built of the latter about 250,000 B.H.P., states that "it is well-known that the lubrication of the piston of a vertical engine is more difficult to effect than that of a horizontal engine. The unavoidable residues of burnt lubricating oil (oil coke) in the cylinder are in the case of the horizontal engine, pushed backwards into a cavity situated below the cylinder bore, wherefrom they are blown out by the blow off valve every time the engine is stopped. On the other hand, with a vertical engine, these residues make their way downward between the piston and cylinder thus causing seizing of the piston rings."

Long experience with horizontal gas engines of large size corroborates this. Lubrication of the piston is not difficult.

In the comparison of the two cycle and four cycle engines the two cycle engines are placed at greater disadvantage than is warranted. It is true that the fuel consumption of the two cycle engine is higher than for a four cycle engine of the same diameter and stroke, but the increase in fuel consumption is not necessarily 18 per cent, and is not due to poor scavenging. The indicated horsepower of a two cycle engine will for its effective stroke, (that is until the exhaust ports open) be equal to that of a four cycle engine. The loss in efficiency is due principally to the work that is required to compress a volume of scavenging air, that may approximate twice the displacement of the power cylinder, to a pressure of about five lb. per sq. in. On this account the fuel consumption per B.H.P. will range from 5 to 10 per cent higher than for a four cycle engine. It should be noted that the Diesel cycle is particularly well adapted to the two cycle type, for the reason that air alone is used for scavenging, and fuel is injected only at the end of the compression stroke. In the case of two-cycle gas engines the mixture of gas and air of a volume not greater than the capacity of the power cylinder up to the exhaust ports must do the scavenging.

Some of the mixture is lost to the exhaust. This is the reason that the thermal efficiency of the two cycle gas engine is not as high as the four cycle. Failure to appreciate this important difference in the op-

[1]Chief Engineer, Gas Engine Department, Snow Steam Pump Works, Buffalo, N. Y.

erating cycles of the oil and gas engines may lead to unmerited condemnation of the two cycle oil engines.

Under the caption "American vs. German Practice" Mr. White lists a number of features wherein German built engines are cited as being superior, compared with American practice. But what is "American practice?" To the writer's knowledge, there has been but one American built Diesel engine on the market until within a very short time past. That one firm has built a certain design that may not have proven the worth of all its distinctive features does not justify calling it "American practice" and then condemning it.

Some of the features cited, as for instance placing the exhaust port on the side walls of the cylinder, were not so designed on account of the difficulty of making heads to contain both inlet and exhaust valves, but rather with a view of bringing out a distinctive design. There is no question but that for a single acting engine the place for all valves is in the head, and it is more than probable that in the near future American practice will lean strongly to this design.

Now that the fundamental patent on the Diesel engine has expired manufacturers in all parts of the country are considering the building of these engines and some are ready for the market.

The screening of the inlet ports of foreign built engines is done for quite a different purpose than to prevent such small foreign particles as might be floating in the atmosphere from entering the cylinder, and that is to deaden the noise of entering air.

One prominent German builder makes the openings in the air intake pipe, narrow sawed slits not more than 1/32 in. wide. These are effective silencers but are not dust catchers. If cylinder walls become scored it is due to the piston seizing. This is caused most frequently from not having made proper allowances for expansion, in which case no method of lubrication can be effective in preventing cutting.

To what engines reference is made when it is stated that the air inlet is usually of the spring poppet type is not clear. Small oil engines are built in this manner, but they are not Diesel engines. The one American built engine which is referred to above has mechanically operated valves both for inlet and exhaust.

As to whether the air compressor should be driven direct from the engine or should be a separate machine is a matter of individual preference. Each arrangement has advantages but the latest designs of engines brought out in the United States seem to favor European practice, that is with the spraying air compressor, driven direct from the main shaft of the engine by means of a crank. It has the advantage of making each engine complete in itself, and not dependent upon an important piece of auxiliary apparatus.

In the paragraph on the oil spray it is stated that it is of the multiple port type on German engines, while on American engines it is most often done with a single jet. It is not clear to what particular design reference is made. From what the writer has learned from an inspection of a number of engines in operation in Germany and under construction in German shops, also from published descriptions, the single spraying valve per cylinder is the rule on all single acting engines. For double acting engines, on account of the rearrangement of valves necessary to allow for a piston rod, the clearance space is divided into two main pockets, one at the inlet and one at the exhaust valve. For such an engine two spraying valves are essential.

There is a design which might be called multiple ported. This is the spray valve which is used when very thick residues or tar is sprayed, the object being to provide for two kinds of oil, a light oil in quantity about 10 per cent of the whole amount required at full load and the balance of the cheaper heavy oil. The light oil is called ignition oil and is sprayed in ahead of the main charge. This arrangement requires two fuel pumps, one to deliver the constant quantity of ignition oil, and the other one under control of the governor, to furnish the variable quantity to suit the changing loads. Extra passages and valves must also be provided in the spray valve casing. European builders are experimenting with similar types of spray valves to take its place, and it is reported that they are meeting with success in these efforts to burn heavy oils without the use of the ignition oil.

The German mechanic is claimed to be of higher grade than the American, and to receive less wages. The latter is true. The former statement needs further proof. Because labor in Germany is lower paid than in the United States, it permits relatively more time to be spent on external finish for appearance only. Who will say that an oil engine will be more efficient if it has polished flywheels, polished cylinder head and foundation bolt nuts, and all of its valve operating mechanism draw filed and polished? Some European builders, under the influence of keener competition, are designing engines with a notable absence of these features. On all essential parts the standard workmanship in the best American shops is fully equal to that abroad.

Experience has proven that there is a wide variation in spray nozzle efficiency. The particular engines that have come under Mr. White's observation must have had very inefficient spraying devices, otherwise such compressions as 700 to 800 lb. would not have been found necessary in order to use 18 degrees gravity California oils.

Recent tests on the "Snow" engines with California and Mexican crudes of as low a gravity as 14 degrees Beaume have demonstrated beyond question that Diesel engines can utilize such oil with a compression pressure not exceeding 480 lb. per sq. in. The oil consumption at full load was .42 lb. per brake horsepower hour.

This removes what would have been a serious disability if it were desired to install oil engines in a plant already using a cheaper oil for steam generation. The main advantage is, however, in being able to dispense with the use of the light oil, which costs according to Mr. White, 41½ per cent more than the heavy oil now used under boilers. The engine running on this oil has a thermal efficiency of 33 per cent which is equal to the average efficiency of German engines using a higher grade of fuel.

With this efficiency and the lower cost of fuel used, the comparison of the Diesel engine and the

steam turbine installation is much more favorable to the oil engine than is indicated by Mr. White's curves.

Assume oil weighing 8.07 lb. to the gallon with .42 lb. of oil consumed per B.H.P. hour, and a generator efficiency of 90 per cent. One gallon of oil will give 12.9 kw.-hrs. at the switchboard. The cost per kw.-hr., with oil at 60c per barrel, is only .111 cents. Another factor favoring the Diesel engine installation is that on account of the relatively slight gain in thermal efficiency due to larger units as compared with steam turbines, a larger number of units could be installed. This would allow keeping as many engines running as are necessary to carry the load. When an oil engine stops its consumption of fuel ceases. In a steam plant, the fires must be maintained, involving a stand-by loss. The fuel cost per kw. output with oil engines could be kept almost constant instead of rising with lower load factors as Mr. White shows in the curve for fuel cost.

The Snow oil engine shows a relatively flat consumption curve. The oil consumption at half load is about 11 per cent higher than for full load. With a 1000 kw. station consisting of five units of 200 kw. each, the average fuel cost per kw. hour should not be more than 6 per cent above the full load rating, or about .118 cents per kw.-hr.

On this basis, the Diesel engine power cost curve crosses the steam turbine curve at about 30 per cent instead of at 75 per cent load factor. At 100 load, the power cost per kw.-hr. is about .57 cents as against about .675 for the steam turbine, or the cost of power with turbines is 18 per cent above the cost with Diesel engines as prime movers.

It is to be noted particularly that on account of the low cost of fuel the oil engine is at a disadvantage in this analysis, because, of the factors which go to make up the total power cost fuel is only about 20 per cent in the case of the oil engine, while in the steam turbine plant fuel is about 50 per cent of the total cost.

Assume 50 per cent increase in the price of oil, and the relative kw. costs become .845 cents for steam turbines and .629 cents for the oil engines, or 34 per cent higher for steam turbines than for oil engines. With the price of oil doubled the figures are 1.015 and .688 cents, or the cost steam turbine power will be 47.5 per cent higher than oil engine power. Stating it another way, doubling the cost of fuel increases the steam power cost 50 per cent while it only increases the oil engine power cost 20.5 per cent.

The cost of a Diesel engine plant installed would in the writer's opinion, be less than the cost assumed by Mr. White, namely $150 per kw., but the above comparison is made on his basis. A reduction of only 10 per cent in the first cost of the plant would reduce the power cost at 100 per cent load factor almost 6½ per cent, and relatively more as the load factor becomes less.

The cost of oil on the Pacific Coast is now low, but with the completion of the Panama Canal new markets will be opened. That the crude oil of 14 degrees Beaume gravity can be used in the Diesel engine with high efficiency and without troubles, will in itself broaden the market for the oil, and thus tend to advance prices.

In view of these facts, every one contemplating additions to existing power plants or the building of new ones should give serious consideration to the oil engine as a prime mover.

At the present time, four cycle engines can be furnished in powers ranging from 50 to 400 B.H.P. and two cycle engines up to 700 B.H.P.

FUEL CALORIMETRY.

BY. J. P. ZIPF.[1]

A fuel calorimeter, simple in operation and very accurate, has been designed by Professor S. W. Parr and is known by his name. The parts of this calorimeter are shown unassembled in Fig. 1 and assembled in Fig 2.

Unlike other calorimeters which use free oxygen, this calorimeter is supplied with oxygen by chemical reaction from sodium peroxide. For more vigorous action an accelerator is accomplished by an addition of potassium chlorate.

A well lighted closet should be used for all calorimeter work so that air currents, which might prevent uniform radiation, can be eliminated. The outside of the calorimeter cup and the fiber insulating case should be entirely free from moisture for the same reason.

Fig. 1. Parr Calorimeter Unassembled.

The calorimeter cup is filled with 2000 grams of water, and together with the cartridge or boom has a water equivalent of 2135 grams. As the oil is also weighed in grams the term $\frac{\text{water equivalent}}{\text{weight of oil fired}}$ is a mere ratio, and if this ratio is multiplied by the rise in temperature of the water in degrees Fahrenheit, the result is heat units per pound of oil, or if temperature is expressed in degrees C. the result is calories per gram.

The water is best measured in a 2000 c.c. flask. About 2003 c.c. of water is used as the specific gravity of water at ordinary room temperatures is slightly less than 1.0.

The thermometer has a range from 65 degrees F. to 90 degrees F. and is standardized by the Bureau of Standards. Graduation errors are known to within .01 degrees F. The scale is divided into .05 degrees

and may be read with care to .005 degrees. The greatest chance for error in fuel calorimetry is in reading temperatures, parallax being difficult to avoid. As seldom more than 5 degrees difference is observed, an error of .01 degrees is equivalent to 0.2 per cent error. The cartridge should be wiped clean and dry immediately before use as moisture will condense on it if it has been standing some time. The top and bottom pieces, as well as the gaskets and electric terminals should be dry, moisture on them taking part in the combustion reaction, and introducing considerable error in the result.

The cartridge should be tightly assembled and 1,500 grams of accelerator, (potassium chlorate) weighed to the nearest .0005 gram, put in. The oil is weighed in a small flash, together with an eye-dropper and about 0.4 to 0.5 grams (8 to 12 drops) dropped into the cartridge on the accelerator, the latter absorbing oil. Upon reweighing the flask of oil and the dropper the weight of the oil is obtained by difference.

A measure full of sodium peroxide is added and the contents thoroughly mixed with a stiff wire. With care no oil, and very little peroxide will adhere to the wire. The sodium peroxide should be that supplied by the calorimeter manufacturer as inferior grades are apt to contain a variable and detrimental quantity of moisture.

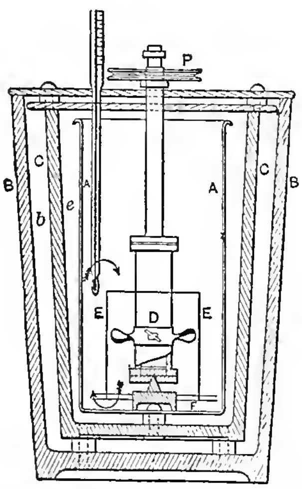


Fig. 2. Cross-sectional View of Calorimeter.

About 3 in. of No. 34 iron wire for firing the charge is looped on the firing terminals and tested to insure a good electrical contact. The firing current can be supplied by a few dry batteries or a storage battery.

The stem of the boom is fastened in place and the vanes attached. The cartridge is then placed in the calorimeter cup, the cover and pulley attached and the cartridge stirred by a small motor for about five minutes. The motor may be of the toy variety and placed in the lighting circuit with a lamp resistance. The system may be controlled with a two-throw switch, so that the motor may be cut out without interfering with the illumination in the closet. The motor speed should be as nearly constant as possible, as a variable speed will cause a variable rate of radiation of the calorimeter. The boom should have from 100 to 150 r.p.m.

The thermometer is placed through a hole in the cover and should be supported so that it does not touch the metal cup. After steady initial temperature has been reached, the firing circuit is completed through the pulley and temperatures read every minute for the succeeding ten minutes.

For a period of about five minutes the temperature will rise until a maximum is reached, after which the temperature will fall due to radiation. The radiation occurring during the first five (or less) minutes is assumed to be at the same rate as that observed during the radiation period.

This assumption is not quite true,[1] but it is nevertheless accepted, as errors are not greater than errors in temperature reading. Readings made during a calorimeter trial of the sample oil under consideration are as follows:

Weight of oil used	.3765 grams
Percent moisture	4.7% (by volume)
Weight of accelerator	1.500 grams
Room temperature	70° Fahrenheit
	Temperature
Time fired.	73.665° F.
Combustion Period.	
1 min.	77.40
2 min.	78.00
3 min.	78.27
4 min.	78.29
5 min.	78.30
Final or Radiation Period.	
6 min.	78.29
7 min.	78.27
8 min.	78.25
9 min.	78.235
10 min.	78.22

Of the heat generated 73 per cent is due to combustion of the oil with oxygen, and 27 per cent to reaction of products of combustion with the excess sodium peroxide. A great number of experiments show that factor .73 is accurate to within 0.1 per cent, regardless of the composition of the fuel. The corrections for reactions for the iron wire and potassium chlorate with the product of combustion are derived from data supplied by the manufacturer. The thermometer corrections are obtained from the Bureau of Standards comparison.

The computation is carried on thus:

Radiation. $\dfrac{78.30 - 78.22}{5} = .016°$ per minute.

	Correction.	Corrected.
Maximum temperature 78.30	—.053	78.247
Minimum temperature 73.665	—.043	73.622
Total rise in temperature		4.625
Correction for chemical and wire		—.373
		4.252
Correction for radiation 6 x .016		+ .080
Rise due to fuel		4.332°

$$4.332 \times .73 \times \frac{2135}{.3765} = 17932 \text{ B.t.u. per lb. of oil as fired.}$$

$$\frac{17932}{.9511} = 18850 \text{ heat units per lb. dry oil.}$$

Three principal difficulties are encountered in the operation of the calorimeter:

[1]For errors in calorimetry and a more exact method of determining radiation refer to Journal of the Society of Chemical Industry, Aug. 15, 1910.

1. The charge fails to fire, which may be due to the following causes:
    a. The charge was not mixed.
    b. Oil was not placed in the boom.
    c. A poor electric contact.
    d. Not sufficient current to cause fuse wire to glow.
    e. The wire burned apart very quickly at a point not in contact with the charge. This may have been caused by a nick in the wire lessening its cross section.
2. Too high a fuel value.
    a. Water was present either as a drop in the cartridge, or as moisture condensed on the surface of the cartridge before the charge was put in.
    b. The cartridge was in poor condition or not tightly put together, either allowing leakage.
3. Too low a fuel value.
    a. Unburned carbon present due to insufficient oxygen. Either not enough accelerator was used or the charge was not well mixed, leaving a mass of free oil which remained unburned.

In operating any calorimeter considerable care is required, and even then results can not be expected with less than 0.2 per cent error. Thus the accuracy of the fuel value determination determines the accuracy of the efficiency of a boiler. Usually two or three trials are made with an oil to get more nearly an average fuel value, and as a check, one upon the other.

When working with an oil containing considerable moisture a water determination should be made in conjunction with a fuel value determination. Water in the oil makes fuel determination unusually variable.

FUEL CONSUMPTION OF DIESEL MOTOR VESSELS.

In a recent number of Denmark Abroad, a monthly review, there are published extracts from the ship and engine journal of the Diesel motor vessel Selandia. which some time ago completed its first round trip to the East. Following the extracts, the review states:

"The weather, especially on the return voyage, was unfavorable and the ship had full cargo both out and back. A steamer of the same size and running at the same speed would use three-fourths more coal, so that the fuel consumption is much cheaper for motor ships than for steamers, especially for those motor ships that can obtain their oil supply near the source of production.

"Aside from this, motor ships have a further advantage in that they can carry fuel sufficient for a distance four times greater than a steamer, and moreover, carry this fuel in their bottom tanks, so that they obtain more cargo room and save the time that it takes to run to ports to take on coal. In spite of the fact that the Selandia made a trip to London and remained there several days, it made the voyage to the East and back in less than four months, which is quicker than any other of the East Asiatic steamers has ever made this trip."

USE OF COAL, OIL AND GAS FOR POWER PURPOSES IN ENGLAND.

C. E. Stromeyer, chief engineer to the Manchester Steam Users' Association, has written some notes on the use of oil as fuel, as well as on the question of oil and gas in internal-combustion engines. In the following table he shows the price above which good coal would have to rise before it would be commercially profitable to burn crude oil instead of coal:

Fuel.	Prices.					
Crude oil, per ton...	$8.52	$9.73	$10.95	$12.17	$13.39	$14.60
Crude oil, per gallon	.035	.04	.045	.05	.055	.06
Good coal, per ton..	6.33	7.30	8.27	9.25	9.97	10.95

Even if the prices of coal and oil should come into harmony, the latter fuel is not quite so advantageous as would at first sight appear. With suitable sprayers the thermal efficiency is doubtless relatively high, but at best this will allow of a gain of only about 5 per cent, and against this has to be set the disadvantage that high efficiencies are associated with high furnace temperatures and also with such boiler troubles as bulges, grooves, etc., especially if the boiler water is at all sedimentary or greasy.

Roughly stated, a first-class modern steam engine utilizes about 12 per cent of the available heat in the coal, resulting in, say, 1.6 pounds to 1.7 pounds of fuel per brake horsepower per hour during a week's work of 55 hours. If the boilers are to be fired by producer gas, for which purpose slack and dust can be used, then each brake horsepower will require about 2 pounds to 2.2 pounds of coal. Internally fired gas and oil engines are approximately twice as efficient as steam engines, which means that they utilize about 25 per cent of the available heat. Crude oil being 37 per cent better than good ordinary coal, oil engines should use only about three-eights of the quantities of coal mentioned above, say about 0.6 pound per brake horsepower. Then, however, as there are no boiler radiation losses over night, a material saving results, and the oil consumption per week of 55 hours may be about 0.5 pound per brake horsepower. Gasoline and similar internal-combustion engines would require about 0.4 pound per brake horsepower. Gas engines have also about the same efficiency as oil engines; but as there is a loss of about 20 per cent in the producers, if these work day and night, and another loss of quite 10 per cent if they have to stand idle overnight, the efficiency of gas engines is only about 40 per cent better than that of first-class steam engines. The following table shows the relationship of prices of the various fuels, each column giving those prices at which equal economy would be achieved if any of the power processes mentioned are used:

Fuel.	Prices per ton.					
Crude oil for Diesel engine	$ 8.52	$ 9.73	$10.95	$12.17	$13.39	$14.60
Gasoline for Diesel engine	10.70	12.17	13.63	15.09	16.79	18.25
Coal for producer-gas engine	2.79	3.29	3.65	4.02	4.50	4.87
Coal for gas-fired boiler	2.07	2.31	2.56	2.92	3.16	3.41
Coal for steam engine	2.43	2.92	3.29	3.65	4.02	4.38

It ought to be profitable to work internal-combustion gas engines, for, although gas producers can be fed with very cheap fuel, the above list shows a profit even when paying 15 per cent more than for steam coal.

ELECTRICAL PUMPING AND IRRIGATION

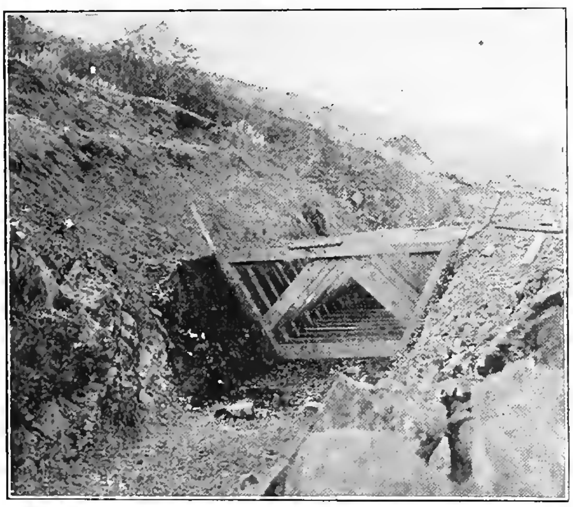
Method of Construction of Concrete Linings.

BY B. A. ETCHEVERRY.

The details of construction in lining canals usually vary with the character of the soil, the size of the canal and the ideas and judgment of the men in charge of construction. There are two general methods. The first method of construction requires forms, behind which the concrete is placed. The second method requires no forms, the concrete being spread on the bottom, and sides of the canal much in the same manner as for sidewalk work. The first method is used when the side slopes are steeper than 1 horizontal to 1 vertical. The second method is used for side slopes of 1 to 1 or flatter. With slopes steeper than 1 to 1 the concrete mixture has a tendency to run down the slope.

Construction of Concrete Lining by Means of Forms.

This method has been used in British Columbia by the Fruitlands Irrigation & Power Company, near Kamloops, by the Kelowna Irrigation Company, and the South Kelowna Irrigation Company. It has also been used extensively on a number of canals in Southern California, and some canals of the U. S. Reclamation Service. It is well adapted to canals less than 8 or 10 ft. wide at the top. The method is as follows:



Form in Place for Earth Backfilling, Kelowna, British Columbia.

For a new canal the excavation is made about 6 in. larger on each side than the finished earth section when ready to receive the lining. For an old earth canal all vegetable matter is removed and if necessary more material taken out in the same manner as for a new canal. In each case the bottom is brought carefully to grade. To shape the canal ready for the lining, the means used on the canals of the Fruitlands Irrigation system near Kamloops, were wooden forms 6 feet long. The form is a trapezoidal trough with no bottom; the sides are tongue and groove or shiplap boards nailed to frames made of 2 in. by 4 in. scantlings cross-braced for rigidity. These forms are placed in position in the excavated section, earth is thrown in between the form and the earth bank and well puddled with plenty of water which was pumped for this purpose. This was found much better and more economical in labor than tamping the earth. Even when using a very wet mud the ground drains sufficiently to allow the removal of the forms next morning. This leaves a very smooth ditch with moist banks ready to receive the concrete lining.

To place the concrete, forms similar to the earth forms are used. This concrete form is smaller than the earth form by the thickness of the lining and is built so as to give a greater thickness of concrete at the corners where the floor and sides come together. The concrete work follows shortly after the earth forms are taken out when the banks are still moist. The concrete forms are placed in position in the finished earth ditch, but instead of placing them continuously in the earth forms, only every alternate form is put in place; then the concrete, which is mixed wet, is placed between the form and the earth and well stirred or cut with thin bars. To protect the earth slope when pouring the concrete mixture, it is well to cover the earth slope with thin galvanized iron sheets, which are pulled up as the concrete is poured in. The sides and bottom are put in at the same time. This gives a good connection at the corners which is very desirable. To do this it is necessary to block the forms above the ground by 3 in. (the thicknes of the lining). To hold the concrete at the ends of the sides and also to hold the form the right distance away from the earth side, 2 in. by 3 in. pieces are placed edgewise between the earth slope and the wooden forms. When the sections have hardened the forms are removed and moved ahead to the adjacent section. In order that the ends of the form will rest on the two adjacent completed sections, the forms should be a little longer than 6 ft. (the length of a section) preferably 6 ft. 6 in. After the removal of the forms the concrete must be prevented from drying out too quickly. This may be done by protecting it with burlap kept wet by sprinkling or by letting water in the completed section as soon as possible. It is preferable to keep the concrete moist for several days after the removal of the forms.

The proper handling of the forms, especially on rough side-hill work, will materially affect the cost. When the lining is started from the upper end of a canal and the work progresses downstream, probably the most economical manner is to place the forms in position for a length of canal which can be lined in one day and begin the concrete work at the downstream end and extend it upstream. The concrete at the downstream end hardens first and this allows the removal of the downstream forms, which are carried downstream in the ditch and placed in position at a distance from their previous position equal to the length of canal lined in one setting of the forms. This procedure allows continuous work and does away with

the necessity for carrying the forms around the side hill.

Joints.

The lining is done in strips in order that all contraction cracks will occur at the joints, which are places of weakness. To separate the sections more distinctly, the edges of the sections may be painted with oil or a strip of tarred paper may be used. By using short sections the contraction cracks are very small and the seepage through them is negligible. It is probable that the cracks in most cases will silt up.

Expansion Joints.

Ordinarily expansion joints are not necessary, but there are some classes of soil in which any seepage through cracks will cause the settlement of the soil and destroy the lining, in which case it may be desirable to do away with all open joints to prevent seepage by using some form of expansion joint. This, however, is quite uncommon, but occasionally occurs where the soil has probably been formed from the coarser material carried by the flood waters of a heavy cloudburst and deposited in small fan-shaped valleys or benches. The lack of rainfall and of the occurrence of further cloudburst has left the soil in an unsettled condition and any seepage water passing through the concrete lining may carry off the finer soil particles into the subsoil below and cause a settlement. For these conditions it may be advisable to use expansion joints spaced about 12 ft. apart and omit all other joints. However, the writer believes that the soil can be thoroughly settled by running water in the excavated canal prior to the construction of the lining. The expansion joint, if desired, could be made by imbedding in the edges of the adjacent section a metal tongue about 4 in. wide. This tongue may be of galvanized iron well painted with oil to prevent adhesion of the concrete.

Method Used Near Kelowna, British Columbia, by Kelowna Irrigation Company.

The method was very similar to the one described above. The main difference was that no separate earth forms were used. The concrete forms were placed in position in the excavated ditch and galvanized iron metal plates were put outside of the concrete form and held away from it by pieces of timber of the thickness of the lining. The earth backfilling was placed against these plates and the concrete was poured in between the plates and the concrete forms. The plates and pieces of timber were pulled out as fast as the concrete was poured in. The above methods of lining by means of forms are limited to side slopes steeper than 1 to 1, because when using a wet mixture even with side slopes between ½ to 1 and 1 to 1, the forms will tend to rise. Bolting the forms together will help to keep them in position.

Construction of Concrete Lining Without Forms.

This method of construction is used extensively for lining irrigation canals in California and other states. It is the method to use for side slopes of 1 to 1 or flatter and is well adapted to large canals. While the first method is usually preferable for new canals on side hills, because steeper side slopes can be used, the second method may be preferable in the valley or in level land and especially in loose sandy soil which will stand naturally on slopes of 2 horizontal to 1 vertical or flatter. The method used in preparing the excavated earth canal for the lining and in applying the concrete lining varies. One of the best methods, used by the Gage Canal Company, Riverside, California, is as follows:

Preparation of earth canal: Place the grade stakes 20 ft. apart along one side of the ditch at a distance of 1 foot from the top of the sloping side. Hold a level rod or cross section rod across the ditch with one end resting on the grade stake, set the corresponding grade stake on the other side and put the bottom stakes in position by measuring down from this rod. By means of these stakes the bottom is cut to grade.

Canal on Side Hill, Belgo Canadian Fruitlands Co., British Coumbia.

To trim the side slopes, iron strips 1 in. wide, ¼ in. thick and of suitable length are driven edgewise in the sloping sides 3 ft. apart, and extending up and down the slopes. The lower ends of these bars are placed in line by means of a line stretched between the bottom grade stakes and the proper slope is given to the bars by using a specially constructed slope level, which consists of a wooden rod on which a level bubble is placed, the bubble coming to the center when the rod is on the desired slope. The iron bars when in position, are guides for a sharp iron straight edge with which all irregularities are shaved off and hollow places filled in and well tamped. It is important to remove all deposits of vegetable character and the sides and bottom must be well settled to prevent the cracking of the lining. It is well to run water in the ditch before the ditch is prepared and lined.

The placing of the concrete should follow the trimming as soon as possible and if the channel is dry it should be thoroughly moistened by sprinkling. The concrete lining is built in alternate strips or panels. To place the concrete wooden guide pieces of the thickness of the lining are laid across the side slopes at the required distance apart which may be 3 ft. or more. The concrete is spread between these studdings and raked to about a uniform thickness, tamped and made smooth and level by means of a straight edge resting on the guide timbers. The floor is finished in the same manner.

LIGHTNING PROTECTION OF TRANSMISSION LINES

BY ALFRED STILL,
Member A. I. E. E., Inst. E. E.

Many papers and articles have been written on the subject of lightning phenomena as they affect the construction and operation of overhead electric power circuits, and the apparatus connected thereto; but in countries where thunder storms are violent and frequent, the interruption to regular service and the damage caused by atmospheric electric disturbances are still considerable, and much has yet to be learned of the nature of lightning and kindred phenomena before our knowledge of the subject can be said to be sufficient to guide us in the design of protective devices which shall be reasonably efficient at all times.

In this article, the writer does not claim to throw any new light on the subject of lightning protection; but he attempts to review briefly the present methods and apparatus which have proved to be of some value as a protection from the effects of lightning and electrical surges; and thus assist the designer of overhead transmission lines in the selection and arrangement of the most suitable protective devices.

Although our knowledge of lightning phenomena is still far from complete, it is generally agreed that a single stroke of lightning is of short duration, frequently not exceeding the one-thousandth part of a second. If an overhead conductor receives a direct stroke of lightning, the potential value of the lightning charge is generally so enormously in excess of the working pressure on the conductors that the lightning leaps over the insulators down the pole to ground. Any charge on the line, which is not sufficiently high in potential above ground to jump over the insulators, will travel along the line in both directions until it is grounded through a lightning arrestor or dissipated because of the ohmic resistance of the conductors. The frequency of such travelling waves will depend upon the natural frequency of the line, and may be of the order of 1000 to 5000 cycles per second. These high frequencies tend to limit the discharge rate of lightning, as the inductance of the line, apart from any choke coils purposely connected thereto, will check the rise of current. If the resistance of an arrestor or the path through which a discharge occurs, were zero, the current passing would be a maximum. If C is the capacity in Farads, and L the inductance, in Henrys, of unit length of line, then $\sqrt{\frac{C}{L}}$ is the quantity that Dr. Steinmetz has called the natural impedence of the circuit; and the maximum possible value of the current will be $I\ max. = E\sqrt{\frac{C}{L}}$, where E is the impressed voltage, which may be considered as something less than the pressure which will cause a flash over at the insulators.

The intense concentration of lightning disturbances is the cause of the difficulties experienced in protecting transmission lines by means of lightning arrestors; experience tends to show that an arrestor does not adequately protect apparatus at a greater distance than 500 feet; yet it is unusual to find arrestors on a transmission line at closer intervals than 2000 ft.

Disturbances are most likely to occur on exposed heights, and on open wet low lands; special attention should therefore be paid to lightning protection at such places.

Apart from the effects of atmospheric electricity, it is necessary to guard against the abnormal pressure rises that will occur on long transmission lines through any cause, such as switching operations, or an intermittent "ground." Over-voltages up to 40 per cent in excess of the normal line voltage can be produced by switching in a long line. High frequency impulses or surges are set up, which, in the special case of an arcing ground, may give rise to a destructive series of surges, a state of things which will continue until the fault is removed. An arrestor which may be suitable for dealing with transitory lightning effects may be quite inadequate to dissipate the charges built up by such continual surges.

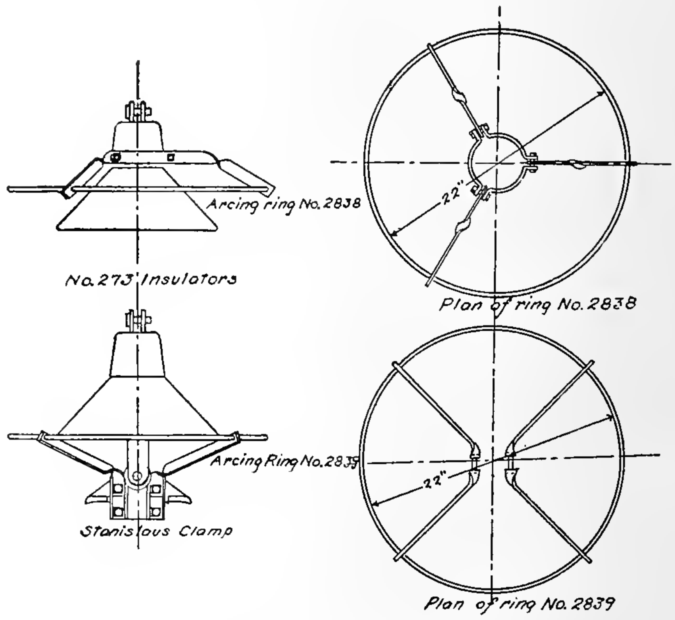
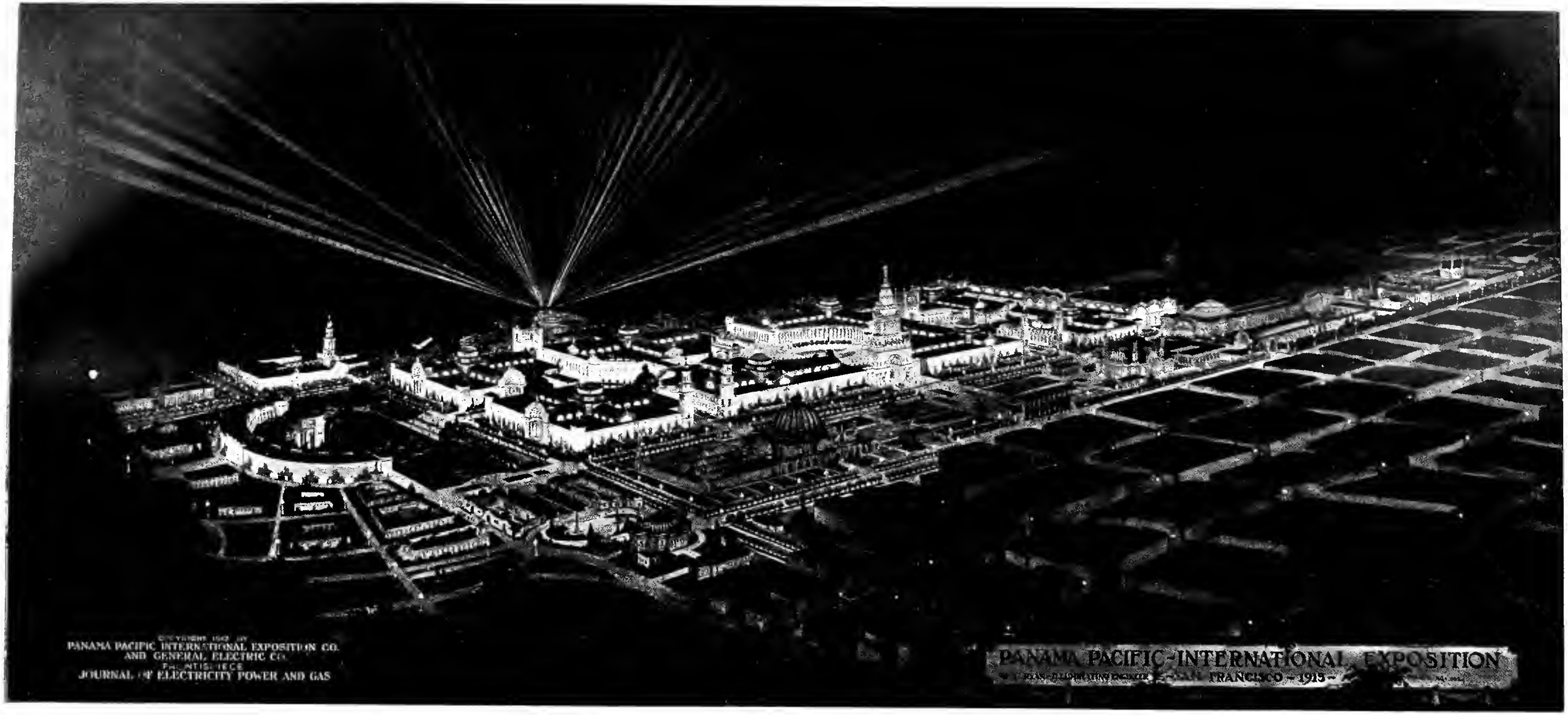


Fig. 1. Grounded Arcing Rings Attached to Standard Type of Insulator.

Protection of Overhead Systems Against Direct Lightning Strokes and Sudden Accumulations of High Potential Static Charges.

Under this heading the ordinary lightning rod and grounded guard wire will be briefly dealth with. If no guard wire is used, lightning rods should be provided at intervals along the line. They may be fixed to every pole or tower, but, in any case, they should not be spaced farther apart than 300 to 400 ft.; unless the spacing of the supporting poles or towers has to be greater than this, for economic reasons, it is especially important to provide them on the poles or towers in exposed positions such as hill tops. They should project from three to six ft. or more above



Proposed Illumination of Panama-Pacific International Exposition at San Francisco—1915

the topmost wire. A convenient form of lightning rod is a length of galvanized angle iron bolted to pole top or forming an extension to the structure of a steel tower. Long lines have been worked satisfactorily for extended periods without lightning rods or guard wires, but these are extra high pressure transmissions, which, on account of the better insulation throughout, are always less liable to trouble from lightning than the lower voltage systems.

Although engineers are still divided in opinion as to the value of the protection afforded by overhead grounded guard wires, carried the whole length of the line above the conductors, it is now generally recognized that this method of protection is efficient. The objections to the guard wire are the additional cost and the possibility of the grounded wire breaking, and falling across the conductors below, thus causing an interruption to continuous working. Trouble due to this cause is exceedingly rare, and at least one engineer (Mr. W. T. Taylor), with extended experience of transmission line work, has never experienced an interruption through the falling of a guard wire.

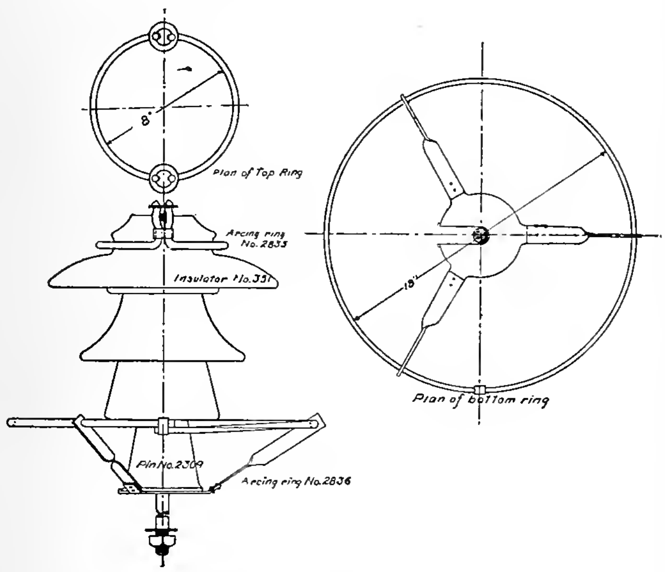


Fig. 2. Arcing Rings Showing Attachment.

It has been suggested that the guard wire or wires should be of the same material as the conductors, in order that the "life" of all the wires may be the same; but there are other considerations in favor of using a galvanized stranded steel cable for the guard wire. This may be the ordinary cable, 5/16 to 7/16 in. diameter, as used for guying poles; but where great strength is required, the Siemens-Martin steel cable, with or without hemp core, is preferable. Bessemer steel wire has not been found satisfactory for this purpose. In the case of the "flexible" steel tower type of line, a strong steel guard wire joining the tops of the towers, adds greatly to the strength and stability of the line, and may even, on long lines, save its cost, by allowing the use of lighter structures and fewer intermediate (dead-ending) towers.

In regard to the position of overhead guard wires relatively to the conductors, it is obvious that a number of grounded wires surrounding the conductors will afford better protection than a single wire above the conductors; and two guard wires are sometimes provided; but the additional cost is rarely justified. Perfect protection cannot be obtained even with two guard wires, and cases have been reported of lightning missing the grounded wire and striking a conductor situated immediately below.

The best position for a single guard wire placed above the conductors is, according to Dr. Steinmetz,[1] such that all the current carrying wires are included within an angle of 60 degrees below the guard wire. Additional wires can be installed in exposed positions, such as the summit, or very near the summit, of a range of hills, or by the shores of lakes or seas where the prevailing winds come over the water. In such positions, an additional guard wire on the side of the conductors may be useful. The guard wire should preferably be grounded at every pole, or at least every 500 feet.

As a special means of protecting insulators from the flash-over caused by lightning, or the power arc following a high potential discharge, the "arcing rings" first introduced by Mr. L. C. Nicholson, may be mentioned. These rings, which are grounded, are placed in such a position as to take the arc, and hold it at a sufficient distance from the porcelain of the insulator to prevent cracking or breakage by heat. The illustrations, Figs. 1 and 2, show the arrangement of the grounded arcing rings attached to standard types of insulator made by the Locke Insulator Manufacturing Company. It is not claimed that these rings will protect an insulator against a direct lightning stroke; but their utility on high pressure lines transmitting large amounts of power has been proved without doubt.

Methods of grounding.—The ground wire from lightning rod, guard wire, or arrestor, on high tension transmission circuits, should be as short and as straight as possible; it need not be of very low resistance; but small impedance is of first importance. The ground connection should have a large surface if possible, the material being of little importance, except that it is not wise to bury aluminum wires in the ground, because of possible electrolytic action. Galvanized iron is a good material. If the ground contact is made with one or more iron pipes buried or driven into the ground, these pipes may be from one to one and a half inches diameter, and a good connection should be made to the top of the pipe, as the inductive effect of an iron tube surrounding the ground wire might be considerable if a connection were made only at the bottom of the pipe. One or more pipes eight to ten ft. long, driven into the ground with 6 in. to 12 in. projection above, will generally be found more effective than buried plates. A very low resistance ground is not essential on a high tension system, and, generally speaking, the special forms of ground plate made of perforated copper, designed to hold, or to be in contact with, crushed charcoal, are unnecessary. If a plate is used, this should be not less than 12 in. square, and it may be of galvanized iron 3/16 in. or 1/4 in. thick, buried as deep as possible in the ground; and, in all cases, an effort should be made to secure permanently damp soil for ground plates or pipes.

(To be continued.)

[1]Discussion of the Committee on "Lightning Protection," of the National Electric Light Association, May, 1908.

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POWER AND GAS

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895.
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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

"Pax Vobiscum" or Merry Christmas

Tradition tells us that the monks of the middle ages carried with their salutation "pax vobiscum"—peace with you—more than its literal interpretation. At this joyous season of the year the Journal would leave with its readers a peace, incident in the lives of busy men, significant of a year's work well spent. Indeed, it would wish to its readers that spiritual content, that rest of soul, which comes alone to the reflecting mind when surrounded by the ring of children's voices, exclaiming over the happy surprises left by "dear old Santa Claus"; to the reflecting mind, which echoes in its thoughts, the bright greetings of life's dearest friends; to the reflecting mind, which thinks again those words of tender messages sent from wife or sweetheart; and above all, to the reflecting mind which in the joyous celebration of this plum-pudding season of the year, sees in one's own inner self a deeper, fuller significance of the manly part he himself must play in the battle of life.

To you then, dear reader, the Journal would wish that for a day, you lay aside your busy cares. May you on this Christmas day experience the fullest meaning of the old monastic saying "pax vobiscum," and may this fullest realization be brought about by the enjoyment of a truly "Merry Christmas" and the anticipation of a "Happy New Year."

Lightning Phenomena and Arresters

Transient alternating current phenomena is a subject truly involving the severest mathematics. To Dr. C. P. Steinmetz, the engineering profession is indebted for the present complete mathematical development in this interesting phase of engineering theory. The great transmission systems of the West in many instances encounter severe disturbances from its subtle effects. Due to a lack of thunder storms, California for the most part represents the district wherein this phenomena is most lacking, while the district served by the Central Colorado Power Company, particularly that portion wherein electrical energy is conveyed over the roof of the continent—namely, the crest of the Rocky Mountains—may be said to represent the other extreme. In this latter instance, lightning conditions are peculiar and are not easily handled, since even the insulators are occasionally thereby shattered. On the whole, then, the development of Western long distance transmission of electrical energy has of necessity been forced to grapple with this problem and today a complete setting forth, in comparatively simple technical terms, of the progress made and the underlying principles involved, will be welcomed by our readers.

The district around the north of Lake Superior teems with real lightning troubles. Elsewhere in this issue, Alfred Still, chief electrical engineer to the mines department of the Algoma Steel Corporation of Sault Ste. Marie, Ontario, Canada, contributes the first of a series of three or four articles on this interesting and perlexing subject. The effect of the corona in dissipating energy in the air when the pressure rises above a certain critical voltage is well

treated in the recent proceedings of the American Institute of Electrical Engineers. Theories and practical developments relating to lightning protection, however, are indeed timely. Mr. Still, a practical engineer of the highest professional standing, puts the matter before his fellow engineers in such a manner that the essential principles involved are clear. His ideas should be of immense value in guiding the engineer in the selection and arrangement of protective apparatus.

The New Agriculture and the Engineer

History records the fact that many years passed after the formation of the American government before a "million-dollar congress" was produced. The California legislature, the controlling body of a commonwealth of the United States undreamed of as ever becoming of financial importance for over three-quarters of a century after the founding of the Union, will this year be asked to appropriate over a million dollars for agricultural purposes alone.

Frequent comment has been made in the columns of this journal relative to the growing uses of electrical energy in rural communities of the West. This gigantic growth is but the reflection of a far-reaching movement, which will not find its ultimate culmination until every hill and valley of that fertile productive country is put under cultivation. So vast and so varied has now become this movement that the Regents of the University of California, through its agricultural department, have decided upon a plan so sweeping and so comprehensive that every nook and corner in that great commonwealth cannot help but feel its uplifting, helpful influence.

"Hogs an' corn" are raised in northwest Iowa—in southwest Iowa the staples produced are "corn an' hogs." Indeed in any other part of that state and in fact in countless Eastern states little variation is found in agricultural pursuits within the particular confines of a commonwealth. How vastly different in that great empire west of the Rocky Mountains!! California alone—between its snow capped peaks to the north and its sun-lit deserts to the south—raises or is capable of raising practically every product possible to bring forth in the temperate and torrid zones. Hence the study of agriculture in the West has a deep and far-reaching significance.

Under the proposed scheme in California the very best and the most earnest investigators that the world produces are to be brought within its confines. Agriculture, in all its various ramifications, is to be scientifically studied and the most improved and profitable methods employed in developing this wonderfully fertile country.

This new undertaking means much to the West. Its life-giving influence, buoyed up by the stimulating effect produced, will be swept back from the borders of the great Pacific and the confines of California into every valley and possibly productive area west of the Rockies. It takes but little thought to fully appreciate what it will mean to the central station and indeed to the engineer. A new, broader field of endeavor will now be opened to him. The electrical and mechanical engineer of the future will find himself a close ally of the leaders in this great movement, if, indeed, he himself becomes not the leader.

The immediate duty of the agriculturist under the proposed regime is, through research and education,

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The Exposition Illumination

The lectures given by W. D'A. Ryan, published elsewhere, are remarkable from a number of viewpoints. The exposition authorities have given another evidence that they intend to secure the best talent available. The beautiful lighting of Niagara, the remarkably brilliant achievements of the Buffalo exposition, the recent widely discussed scintillating effect of the General Electric Building at Buffalo—all attest his ingenuity. As Mr. Ryan is the illumination expert of one of the largest electrical manufacturers in this country, his appointment might give offense to any competitor large enough to be affected by the advertising thus secured by Mr. Ryan's employers. It is not generally known that when the exposition managers requested an expression of views on this point by the principal competitor, its local representative said at once that Mr. Ryan stood in a class by himself, and that the exposition managers would be derelict in their duty if they missed the opportunity to secure such a man, that his company would welcome Mr. Ryan's coming. Unfortunately such breadth of view often is conspicuously absent in so-called big business.

Mr. Ryan does stand in a class by himself in that his results, beautifully striking, are secured by the ingenious application of simple devices. His work at this exposition will fascinate here as it has mystified and delighted assembled multitudes elsewhere. His fellow engineers like to do him honor for what he is and for what he has done.

Great doers are seldom, however, talkers. Sometimes it is difficult for a man who has done things to accurately tell the reason why they were done, especially in giving an off-hand address. Some of the engineers who honor Mr. Ryan for what he is and what he has done can explain his lack of accuracy with regard to some minor theoretical details only on such an assumption. To state that the red color of a piece of glass is due to the fact that it is vibrating at the particular rate at which red rays vibrate is somewhat at variance with the present accepted theory of light. Or to fail to state the fact that the changing color combinations of a soap-film projection is a direct measure of bubble thickness in terms of the wave length of that particular color, indeed allows to pass unnoticed one of the most interesting phenomenon of nature. The satisfying of such a curiosity that leads one to delve into the underlying principles of every day experience, even though a practical application be not always in sight, differentiates the real student from the rule-of-thumb experimenter. All who have seen Mr. Ryan's charming results know that his working thoughts are as clear and as precise as are his beautiful effects. Though the true student regrets some of Mr. Ryan's untechnical statements, still his pleasing personality in the course of his informal talks, sweeps all before it.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Geo. A. Gray of Chicago is traveling on the Pacific Coast representing Crouse, Hinds & Co.

P. B. Hyde of the Edison Company leaves shortly for an extended trip to Los Angeles and Southern California.

Miles Steele of the Benjamin Electrical Works is attending the Oregon Electrical Contractors' Convention at Seattle.

W. W. Hanscom returned to San Francisco last Wednesday after a three weeks' stay in Los Angeles.

W. F. Neiman has left for an extended trip over the northwestern division of the Great Western Power Company.

M. L. Scobie of the Pacific States Electric Company has returned to his desk after an enforced absence of three weeks due to a sprained ankle.

W. D'A. Ryan, consulting illuminating expert for the Panama-Pacific Exposition Company, left for the East last Tuesday via Los Angeles.

J. R. Bibbins, local representative of Bion J. Arnold at San Francisco, expects to leave for the East after January first to be gone several weeks.

A. H. Halloran, managing editor of this journal, is at Trinity Hospital, San Francisco, recovering from a successful but painful operation on his ear drum.

Roy T. Guppy, chief engineer of the Southern Pacific company's electrification work now under way in and about Portland, is a recent San Francisco visitor.
Portland, is a recent San Francisco visitor. After a brief visit to Los Angeles, Mr. Guppy will return again to his activities in the north, arriving Christmas eve.

J. B. Leonard, engineer, announces the demand for open hearth steel is increasing so fast the Pacific Coast Company cannot fill new orders now being placed for this product before April.

H. A. Barrie, general manager, and **E. R. Davis**, electrical engineer of the Pacific Light and Power Company of Los Angeles, arrived in San Francisco last Tuesday, leaving the same day for Fresno on business connected with the Big Creek project.

Arthur G. Munn, president, and **Stanley S. Stonaker**, secretary of the California Glass Insulator Company at Long Beach, Cal., arrived in San Francisco Sunday on a business trip. Mr. Munn reports a growing popularity for California glass insulators on the part of the railroads, telephone, telegraph and other Western consumers.

Santa Claus (Briggs) that jolly, jovial, genial fellow, visited the Jovian Meeting, Tuesday last, which was attended by sixty or more members. His sack contained many tokens for those present and of course "Lucky" Charlie Wiggins pulled the horseshoe, while "Shining Light" H. E. Sanderson and Frank Stone, "That Handsome Fellow," fell in for a pretty little hairbrush and mirror respectively. Then came Captain Jackson, with a little sword and Colonel Strong with his stimulator; C. C. Davis and his auto; and for dear Brother Hillis a watch and chain in recognition of his past record for attendance and promptness, while Will Berry was the happy recipient of a golf bag in token of his golfing propensities. Through the interest and efforts of W. S. Hanbridge, many useful and attractive capital prizes, consisting of electric pocket lamps, water heater, electrical games, cigar lighter, etc., were awarded to members holding lucky numbers.

OREGON SOCIETY OF ENGINEERS

The regular monthly meeting of the Oregon Society of Engineers was held Thursday, December 19. John T. Whistler, formerly of the Reclamation Service, gave a talk on "Some of Our Water Resources."

PORTLAND JOVIANS.

The regular Jovian Luncheon Club met at the Hazelwood at noon, Thursday (12th). The chairman of the day was Arthur Derby of Jno. F. Robeling Sons. The speaker of the day was Marshall M. Dana, and his subject was "Immigration, Present and Future, With Regard to Opening of the Panama Canal."

LADIES' NIGHT AT LOS ANGELES SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The Los Angeles Section met Tuesday evening, December 17 at 8 o'clock. The meeting was entitled "Ladies Night" and all enjoyed a pleasant and interesting address by W. D'A. Ryan of Schenectady, who is the engineer now acting in a consulting capacity for the Panama-Pacific Exposition. Mr. D'A. Ryan spoke on "Illumination."

ENGINEERS' & ARCHITECTS' LUNCHEON, PORTLAND.

The Joint Engineers' and Architects' luncheon at the Portland Hotel, Tuesday, December 10, was presided over by W. H. Graves civil and hydraulic engineer. The speaker of the day was by Geo. M. Cornwall, editor of "The Timberman." He dwelt at length upon the necessity for a course in Logging Enginering being placed in the Oregon Agricultural College at Corvallis. The luncheon was well attended.

BIENNIAL MEETING OF THE ELECTRICAL COMMITTEE, NATIONAL FIRE PROTECTIVE ASSOCIATION.

The biennial meeting of the electrical committee of this association will be held in March, 1913, in New York City.

The provisions of the National Electrical Code as they now exist will be the principal matter for consideration, and it is requested that any desired change in, or addition to, the Code, also all sub-committee reports, be forwarded to Ralph Sweetland, Secretary of the Electrical Committee, on or before January 15, 1913, in order that they may be printed in the Bulletin, the committee and other interested parties thus having opportunity to consider the same advance of the meeting.

STUDENT BRANCHES OF A. S. M. E. AND A. I. E. E. TO TAKE INSPECTION TRIP.

Under the leadership of Robert Sibley, professor of mechanical engineering and editor of the Journal of Electricity, Power and Gas, the student branches of the American Society of Mechanical Engineers, and American Institute of Electrical Engineers at the University of California will make an inspection trip to various engineering undertakings in the State. The trip will start at Los Angeles at the opening of the second week in January. After visiting the big power plants of the Southern California Edison Company at Long Beach and the Pacific Light & Power Company at Redondo, a visit will be made to the oil fields and power plants in and about Bakersfield and the Kern River. The final visit will be made at Fresno and the Big Creek project of the Pacific Light & Power Company. Those signing for the trip are as follows: Robert Sibley, Mrs. Robert Sibley, Geo. Gautier, M. E. Page, Roy Newton, Arnim Graff, G H. Hagar, J. A. Villegas, F. B. De Lano, Leland Weber,

Ray Hansen, C. I. Kephart, L. W. Doyle, C. L. Reed, Ralph Reynolds, H. K. Winterer, C. B. Merrick, R. A. Waite.

PORTLAND SECTION, A. I. E. E., MEETING.

The third regular meting of the Portland Section, A. I. E. E., was held in the Assembly Hall of the Electric Building, on Tuesday evening, December 17th, at 8 o'clock. L. D. Gilbert, member A. S. M. E., associate A. I. E. E., engineer for the Oswego-Portland Cement Company, presented the paper of the evening, the subject of which will be "Electricity as a Factor in the Development of the Cement Industry."

SEATTLE SECTION, A. I. E. E. MEETING.

The December meeting of the Seattle Section was held Saturday evening, December 14th, at 8 p. m. in the assembly room of the Chamber of Commerce, eighth floor of Central Building. P. D. Naugle, of the United States Navy Yard, read a paper on "The Installation and Operation of Wireless Apparatus," and prepared discussions thereon were presented by other members. A paper entitled "Notes on Modern Telephone Practice" was also presented by Messrs. T. F. Cales and L. P. Crim, of the Pacific Telephone & Telegraph Company. Interesting discussion followed the presentation of both papers.

PORTLAND SECTION, N. E. L. A., MEETING.

On the evening of December 10, fifty members of the Portland Section of the National Electric Light Association met at the Multnomah Hotel and listened to a discussion of the proposed Workmen's Compensation Act which will be submitted to the Oregon legislature in January, 1915. The proposed act was drawn up by a committee appointed by Governor West, consisting of representatives from the State Grange, labor organizations and employers and provides for an industrial insurance fund which will be maintained by companies who have workmen engaged in hazardous occupations. The payments to the fund will amount to three per cent of the monthly payrolls for laborers engaged in such hazardous occupations, the three per cent to be paid by the company. The employees, themselves, will pay one-half of one per cent of their wages and the state will contribute an amount equal to the employees so that the total payments received by the fund will amount to four per cent of the workmen's payroll. The schedule of allowances has been drawn up providing for various payments in cases of death, permanent disability, partial disability and for first aid to the injured. The fund will be in charge of three commissioners appointed by the governor.

The distinctive feature of this bill will be, that unlike the Washington law it will not be compulsory. In cases where companies and their employes decide to take advantage of the compensation act an agreement will be made between the employer and his workmen and the employer will then arrange to make the necessary payments to the state fund. The proposed Oregon law differs from the Washington law also in that it has done away with various classification of risk and various rates of insurance therefor. The framers of the Oregon bill state that while there is certainly a difference in the character of the risks, yet no one in this country has gathered sufficient statistics showing what these differences actually are and it is not believed possible to incorporate them in the bill until such time as sufficient statistics are gathered to demonstrate the varying degree of hazard. Instead of calling for payments from 1 per cent to 10 per cent of the payroll, as in Washington where the payments vary according to the hazard, the Oregon bill will call for a flat four per cent contribution as outlined above.

A. I. E. E. RESOLUTION ON PATENT SITUATION.

The American Institute of Electrical Engineers, acting through its officers and board of directors, has passed a resolution urging congress to provide for a commission, made up of unbiased, independent, non-partisan men of such national standing as will command the respect of the whole country; and chosen from different walks of life; and not more than one from any one calling or interest; and serving without pay. Such commission to hold public hearings, and otherwise, as may appear to them best, to make a thorough and careful study of the American Patent situation, and to prepare and submit a comprehensive report and recommendations to Congress for such changes, if any, as may, as the result of their study, appear to them expedient, whether in the patent office, in the method of court procedure, or in the organic patent law, and recommendations as to the legislation they would propose for effecting said changes. Congress is also urged to hold in abeyance all proposed legislation affecting the patent system in whatsoever way until such time as the said commission shall have had ample opportunity to hold the said hearings, and make the said study and report.

NEW PUBLICATIONS BUREAU OF MINES.

Bulletin: Bulletin 49. City smoke ordinances and smoke abatement, by S. B. Flagg; 1912; 55 pages.

Technical Papers: Technical Paper 27. Monthly statement of coal-mine accidents in the United States, January to August, 1912, including statistics for 1910 and 1911, compiled by F. W. Horton; 1912; 24 pages. Technical Paper 29. Training with mine-rescue breathing apparatus, by J. W. Paul; 1912; 16 pages.

Miners' Circulars: Miners' Circular 9. Accidents from folls or roof and coal, by G. S. Rice, 1912; 16 pages. Miners' Circular 10. Mine fires and how to fight them, by J. W. Paul; 1912; 14 pages.

NEW CATALOGUES.

The Benjamin Electric Company has issued a booklet on their "Loktite" car fixtures. Under this heading fixtures Nos. 2377-2378, illustrations of which appear in the advertising section of this issue, are intended for single unit ceiling car fixtures with standard glassware, having 2¼-inch fitter. Shade is securely held in position by a special safety holder, in which the usual holder screws are replaced by three spring clips, forced into engagement by a cam ring. The latter, in turn, is bolted to the casing. It can therefore not jar loose. A 2-piece porcelain receptacle provided with lamp grip secures the lamp against loosening or falling. As shown in the accompanying diagram, the receptacle may be attached in two ways: (1) to a strap; or (2) directly to the car ceiling. Fixtures for form "O" position are regularly furnished with strap. The form "H" position is secured by omitting strap and using oak base block. Sockets used are National Electric Code Standard.

"Direct Current Railways of 1200, 1500 and 2400 Volts" is the subject of a most valuable bulletin (No. 4958) from the General Electric Company. After a brief introduction regarding the economy of the higher voltage, detailed consideration is given to the cost of electrifying four types of road with 1200-volt equipment as compared with 600 volt. This comparison gives most minute tabulations of all factors of first cost, fixed charges and operation and maintenance, showing a saving of from 10 to 20 per cent in the cost of electrification material in each case, as well as showing the reliability of the higher voltage. All the apparatus and equipment required is illustrated and described most carefully, the treatise concluding with about 90 pages of illustrated description of typical installations throughout the country. This brochure is so elaborate that it will be sent only to those to whom it will of immediate interest. To such it should form one of the most indispensable books ever published.

THE ELECTRICAL CONTRACTORS' DEPARTMENT

THE RELATION OF THE OREGON ELECTRICAL CONTRACTOR TO THE UNDERWRITERS' INSPECTION WORK IN OREGON.

(Concluded.)

BY F. D. WEBER.

We are charitable towards the electrical contractor as we know the things he has to combat. The road he has to travel is not strewn with roses. Some of the things he has to contend with are the following:

1—Attractiveness of the business to amateurs.

2—Carelessness and ignorance among workmen.

3—Indefinite specifications furnished by architects.

4—General disposition of public to desire cheapness.

5—Competion among the contractors themselves—"cutthroat methods."

6—"Carpet bag" competition.

7—No state restriction as to license restrictions for contractors.

8—Lack of experience within the ranks of the contractors.

9—Faulty or incorrect inspections by inspectors.

10—Lack of co-operation among contractors.

11—The rapid changes taking place in the science of electricity.

12—Lack of co-operation between architects and contractors.

13—Lack of co-operation between the jobbing trade and the electrical contractors—as regards price protection.

14—Ignorance on the part of a high percentage of the electrical contractors as regards plain business methods and how to figure their legitimate profits.

15—Lack of pride in their work and business.

16—Lack of proper co-operation between central station and contractor.

A few samples of architects' specifications will show their loose methods:

Switch boxes to have dull, square brass plates with ebony buttons.

Make wiring complete, ready for connection; extra heavy fuse for electric iron.

Bell plate at front and rear door to match hardware.

The electric contractors to furnish a certificate from the Willamette Falls Power Company, which has been out of business for years in this state.

Wire building in a workmanlike manner, with the best insulated copper wire of sufficient size to supply the necessary voltage and in accordance with the city ordinance rules and regulations, and also those of the local electric light and power company.

All joints are to be well soldered and wrapped.

All wires must be insulated with approved earthenware insulators.

All outlets are marked by a circle on plans.

Wire building in the best manner for Devonial telephone and finish with No. 1172 telephone in each apartment (fifteen in all) and connect with main entrance, and finish there with Devonial No. 157, with fifteen buttons. All to be set up in first-class working order. Details for work to be gotten out later.

Let us pause for a minute and see what the future holds in store for the electrical contractor of Oregon. By deduction from the past we can see nothing but a wonderful improvement in the conditions surrounding electrical contracting. The formation in New York in November of the "Society for Electrical Development, Inc." composed of the National Electrical Contractors' Association, the Electrical Supply Jobbers' Association, the National Electric Light Association and representatives of some of the electrical manufacturers, sounds the first keynote of a revolution in favor of the contractor. In a few short years he will be proud of his business, if he also meets this movement in his favor and makes the most of his opportunities.

The use of electricity will become more universal. Rates must go down, and with the more efficient cooking apparatus that will be developed, a new field in this line will open up. Even in some of the European countries heating is done by electricity at the present day.

Therefore it is now up to the electrical contractor to get on a firm basis and assist in his own development.

One of the best methods, we believe, to adjust all troubles and business differences is for the Oregon Electrical Contractors to join the N. E. C. A., and through that organization start a campaign of education. There is a condition that should be handled in this state and it is this: We have one city, and may be shortly another, in which the inspector is the only contractor. Now how can a man inspect his own work? This is a hard condition for us to handle, but your association could do so very easily.

There is another practice among some contractors in Oregon which should be stamped out also by your association, and it is the practice of taking a contract to do a completed job at a stipulated price. The work is inspected and condemned. The contractor makes the necessary changes, after which the job is accepted and the contractor renders a new bill covering all the cost of the changes required by the inspection department. Many times suit is brought by the contractor, and it is an even chance whether he collects his bill or not, the courts being poor judges of this kind of practice.

There are many more that in time you can right, and in closing I desire to repeat that I, as inspector of the U. E. R. B., desire to always co-operate with the electrical contractors of Oregon in every way possible to improve conditions.

PROFFER OF ASSISTANCE FROM PORTLAND SECTION, A.I.E.E. CONCERNING ELECTRICAL CONGRESS, 1915.

At the last meeting of the Portland Section of the American Institute of Electrical Engineers, there was a considerable discussion as to what might be done by the Portland Section, as a Section, or by its individual members, in der to best assist in the work of the Committee on Organization of the International Electrical Congress.

It was the concensus of opinion that financial assistance would be most acceptable, and the secretary has written to Mr. Henry A. Lardner, vice-president on Pacific Coast Relations of the Committee on Organization of the International Electrical Congress as to the details of the financial problems which will have to be taken care of, and for advice as to the raising of funds and the uses for which the amounts raised will probably be put.

Mr. Lardner has replied that he has not as yet been officially advised by the Executive Committee members as to final plans for financing the Congress, nor just what will be expected of the local or Pacific Coast members of the Institute.

It is certain that the offer of assistance of the Portland Section will be most acceptable to the Committee on Organization, and it is a pleasant indication of the great interest in this endeavor of the American Institute of Electrical Engineers which is taken by the Portland Section, and in addition shows very kindly feeling toward the San Francisco Section, who naturally have the International Electrical Congress most thoroughly at heart.

NEWS NOTES

INCORPORATIONS.

SAN BERNARDINO, CAL.—Amended articles of incorporation have been filed by the Cucamonga Water Company by E. T. Wright, N. W. Sewell, J. C. Lynch, W. B. Nicholson and John Lynch. The concern is capitalized at $100,000.

ELKO, NEV.—The Elko-Lamoille Power Company has been incorporated, with principal office at Elko. The capital stock is placed at $100,000. The original subscribers are: J. G. Scrughan of Reno, Frank Fernald Sr., Webster Patterson, H. S. Taber, L. J. Wintermantel and B. G. McBride.

ILLUMINATION.

ALAMEDA, CAL.—Sealed bids will be received up to January 7, 1913, for the furnishing of electroliers, lamp posts and tops for the department of electricity.

MIAMI, ARIZ.—Work has been commenced on the installation of the first unit of the electric light plant to be located on lot 37, in the building in the rear of the Miami townsite company building.

REDWOOD CITY, CAL.—On January 24th, the people of this city will determine by their votes whether funds shall be provided for the making of much needed improvments and extensions of the street lighting system.

EL PASO TEXAS.—The Alpine Power Company has received a bill of lading for equipment for the new lighting system. The new plant will have a capacity of more than 3000 20 candle power lamps, and will be installed and in operation before Christmas.

NEWPORT, CAL.—Sealed bids will be received until December 30th, for $25,000 worth of municipal light bonds. Said bonds are 25 in number, of denomination of $1000 each, bearing interest at 5 per cent per annum, payable semi-annually, and are for the purpose of constructing a municipal light works at Newport Beach.

VENICE, CAL.—Proceedings have been started for the installation of ornamental concrete lamp posts from Marine street south to Horizon avenue, as far east as Central avenue. This will necessitate erection of 600 posts, each of which will be surrounded by a cluster of one large and 6 small incandescent globular lights.

ECHO, ORE.—The city council of Echo has granted a 20-year franchise to Joe Roth, of Hermiston, Ore., and James Ralph of Spokane to install an electric light system. The power will be generated from the Umatilla River at Hermiston. Work is to begin within 90 days and to be completed within eight months from date.

SAN FRANCISCO, CAL.—The engineering department of the Pacific Gas & Electric Company, 445 Sutter street, has prepared plans and is taking figures for the construction of a reinforced concrete building which will be erected at the foot of Market street in Oakland. The work is to be handled through the office of Mr. Parker of this city.

MEDFORD, ORE.—Because Medford, according to a statement of Mayor Canon, is paying a higher rate for electric lights than any city in the state, and because an amendment passed at the last general election gives councils the right to fix the rates, a committee has been appointed to submit a uniform rate to be charged by the Oregon-California Power Company.

SAN FRANCISCO, CAL.—W. D'A. Ryan, electrical engineer in chief for the exposition, and one of the foremost authorities on questions of illumination in the United States, has exhibited some of the wonderful innovations in lighting, which he has worked out, and which will be utilized for the first time at the Exposition. The exposition directors were given a lecture and demonstration and the ways and means committee and the women's board were also Ryan's guests. "A popular expression is to be heard nowadays that all expositions are alike, but in 1915 we are going to show the world that the Panama-Pacific International Exposition is the exception to that rule," said Ryan. "The lighting of the grounds and buildings of the exposition will mark an epoch in electrical science, and will have a world-wide educational influence in problems of illumination. Where. in former expositions, buildings were but outlined by lights or at the best brought out in patches by great flares of light. this exposition will be illuminated softly and evenly so that the light will enhance the beauty of the buildings and courts from an architectural standpoint. There will be no glaring light that will weary the eye and result in headaches, the illumination being practically all indirect and from masked batteries."

TRANSMISSION.

TROPICO, CAL.—Sealed bids will be received up to January 23d for the electric franchise applied for for heating, lighting and power purposes, to be maintained for 40 years.

LOS ANGELES, CAL.—Work has begun on the extensions of the Edison Electric lines west from La Canada, through the Holmes-Walton tract to La Crescenta and Sunland. The Edison Company is under agreement to the Holmes-Walton Company to have power at the pumping plant by January 1.

VISALIA, CAL.—The first of a series of suits have been filed in the Superior Court against property owners of Visalia, Tulare and Woodville districts, by the Pacific Light & Power Company asking for a right of way for steel towers upon which to carry their high tension electric power from Big Creek to Los Angeles.

KLAMATH FALLS, ORE.—The California-Oregon Power Company has finished the extension of its high-tension line from Dorris to Klamath Falls thereby completing a system of 435 miles of main line distribution in Southern Oregon and Northern California. Up to the present time Klamath Falls has been supplied from the company's local plant, on Link River, but the rapid growth of that city and section was overtaxing this, and it was found necessary to bring in electricity from the big plants at Klamath River and prospect work on the large dam at Ward Canyon, in Siskiyou county, is progressing rapidly; the false dam which diverts the Klamath River through a tunnel, drying the river bed, is nearing completion. A spur track has been built into the works, from the Klamath Lake Railroad, and the crushers and mixers have been put in place, so that the concrete runs directly to the working place. This diverting dam will be 150 feet high and 310 feet along the crest. The power house is being built to contain four 10,000 kw. units.

LOS ANGELES, CAL.—To furnish motive power for additional street railway lines in Southern California, the Pacific Light & Power Company is bringing hydroelectric power from the Sierras, 240 miles to Los Angeles. The immediate expenditure exceeds $10,000,000 and the total development contemplated involves twice that amount. Nearly 3000 men are at work now in the Big Creek region, pouring cement for the dams, at the rate of 2200 barrels a day. Ten miles of railroad system have been built for construction purposes. Progress has been so rapid that the initial installation will be

made August 1, next. At that time, 70,000 horsepower will be ready for delivery over the new line—almost as much as the present aggregate capacity of the company's hydroelectric and steam plants. Ultimately the Big Creek line will furnish 300,000 horsepower and all construction work has been done with that end in view. When the great work is complete it will furnish power sufficient for street railway lines more than three times as extensive as the present Pacific Electric and Los Angeles systems.

SALT LAKE CITY, UTAH.—In addition to supplying the Utah Copper Company with power for the operation of its mines the Utah Light & Power Company, recently organized by Electric Bond and Share interests, will also supply the power for the electrification of the Bingham and Garfield Railroad. The Utah company is the operating company which will succeed the Utah Securities Company and will be formed by a consolidation of the Telluride Power Company, the Utah Power Company and several power companies in Utah. The entire stock of the Bingham and Garfield Railroad is owned by the Utah Copper Company, and its bonds are convertible into stock of the copper company at $50 a share at any time before July 1, 1914. Bingham and Utah has about 42 miles of track and operates between the mines of the copper company and a connection with the S. P. L. A. & Salt Lake road at Garfield. A cut-off is now being constructed over Soldier Summit. The work of electrification is expected to be completed by July 1, 1913, the work being done by the General Electric Company.

TELEPHONE AND TELEGRAPH.

SAN FRANCISCO, CAL.—An extensive system of government supervision over wireless telegraphy has recently become effective, four months after the date of the enactment of the law. San Francisco and Seattle will be among the divisional headquarters.

PORTLAND, ORE.—Equipped with a wireless telegraph apparatus, by use of which it is expected to communicate with San Diego, Honolulu and other distant cities, the Portland Young Men's Christian Association has just established one of the first complete schools in the West for instruction in use of "wireless." It is said to be the most complete apparatus possessed by any Y. M. C. A. in the country, and the association has been a pioneer in the education of operators.

PORTLAND, ORE.—The cost of establishing an automatic or semi-automatic telephone system of 7000 main and 13,000 residence stations, including all material, construction, tools and supplies, and one main and eight branch fireproof buildings will be $2,987,967, according to the preliminary report of Frank B. Hall, telephone engineer employed by the city to plan such a system and estimate its cost. The report was submitted to the city council by Superintendent of Public Utilities A. L. Valentine, to whom it was rendered.

SAN FRANCISCO, CAL.—The Pacific Telephone & Telegraph company will retire the $5,000,000 two-year 5 per cent notes due on January 5 from the proceeds of the sale of preferred stock to the American Telephone & Telegraph Company. Of the $32,000,000 6 per cent cumulative preferred stock authorized and issued by the Pacific Company, the American owns $21,727,200. Of the parent company's holdings of preferred stock, $18,000,000 was purchased just before the California public utilities law went into effect, and a portion of the proceeds of this sale will be used to retire the notes. The $750,000 Sunset Telephone & Telegraph first 6s, due July 1, 1913, will be taken care of by the sinking fund, while the $2,500,000 consolidated 5s of the same company will doubtless be called at 105 on October 1, 1913, from the proceeds of the sale of $3,000,000 unissued Pacific Telephone & Telegraph bonds.

TRANSPORTATION.

PORTLAND, ORE.—Double tracking of the Oregon Electric between Portland and Garden Home has been started in earnest.

STOCKTON, CAL.—The Stockton Electric Railway Company has been granted the franchise to extend its Poplar street line into the Baldwin & Howell tract in the northwestern section of Stockton.

FRESNO, CAL.—That a bonus of $40,050 has been subscribed for the proposed railroad to the new townsite of Biola, adjoining the Barstow Colony, is the statement made by J. B. Rogers, who, with San Francisco people, is building the line. Rogers states that the instrument filed in the recorder's office on Saturday is somewhat misleading and that the $6350 bonus reported, was only that collected from individual land owners. He had put up a bond to assure the building of the road or the return of the bonus money and it was for this reason that the agreement was filed. The Villa Land Company, which owns the townsite of Biola has put up a bonus of $25,000 and the firms of Murray Inc., the Kerman Land Company and the owners of the Sycamore lands, have subscribed together, the sum of $8700. The other $6350 brings the total up to $40,050. Teams are now at work on the railroad grade, but the heavy grading will probably not start much before next week. The line is to be completed within six months from the time of the beginning of construction.

WATERWORKS.

OAKLAND, CAL.—Sealed bids will be received up to December 30th, for the construction of a water plant in portions of County Road No. 1008, Main street and Lincoln street in the Irvington Road District.

LOS ANGELES, CAL.—The Public Service Commission will decide this week under what law regulating extensions of water service it will extend the water service into Rodgers Park district. The board decided upon the extension, but left open the question which law shall be followed.

SANTA MONICA, CAL.—Anticipating the early arrival of Owens River water, Mayor Dow has signed a contract with Quinton & Cody, hydraulic engineers of Los Angeles, to furnish a statement at the earliest possible date as to how much should be paid the local water companies for their distributing systems. This will form a basis for a bond issue election.

OAKLAND, CAL.—The Alameda petition for the formation of an intermunicipal water district has been filed with Mayor Mott, providing enough signatures from the seven cities of the proposed district to ask the supervisors to call a special election. The petitions will be filed with the supervisors as soon as the petitions of San Lorenzo and Mt. Eden are sent in. The Berkeley petition was filed on Wednesday. The territory included in the petitions stretches from the Contra Costa county line on the north to Alvarado on the south. The district will have the power to condemn the plants and properties of the Peoples Water Company or the Union Water Company, to purchase land and to own and operate a water system.

OAKLAND, CAL.—C. W. Blabon, E. M. Fossing A. Hallen, J. A. Eveleth, L. Yates, A. C. Sanford and Miss Edna Taylor have filed a complaint against the Peoples Water Company. The complainants are residents of Peralta Park, Berkeley, and charge that when they asked for a water service the company offered to furnish a supply only upon condition that the residents of Peralta Park, at their own expense, install the pipes and mains. The complaint charges that the proposal of the company required that the pipes and mains become the water company's property. The complainants ask the Railroad Commission to compel the company to give service in Peralta Park. This complaint calls upon the Commission to exercise a power not previously invoked.

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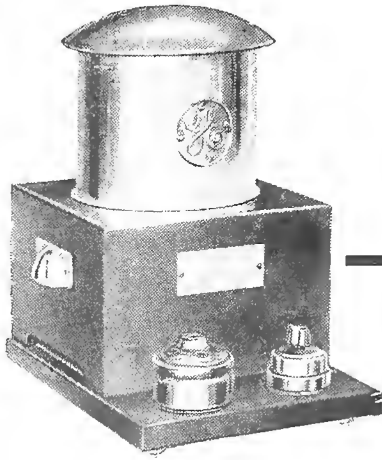

JOURNAL OF ELECTRICITY
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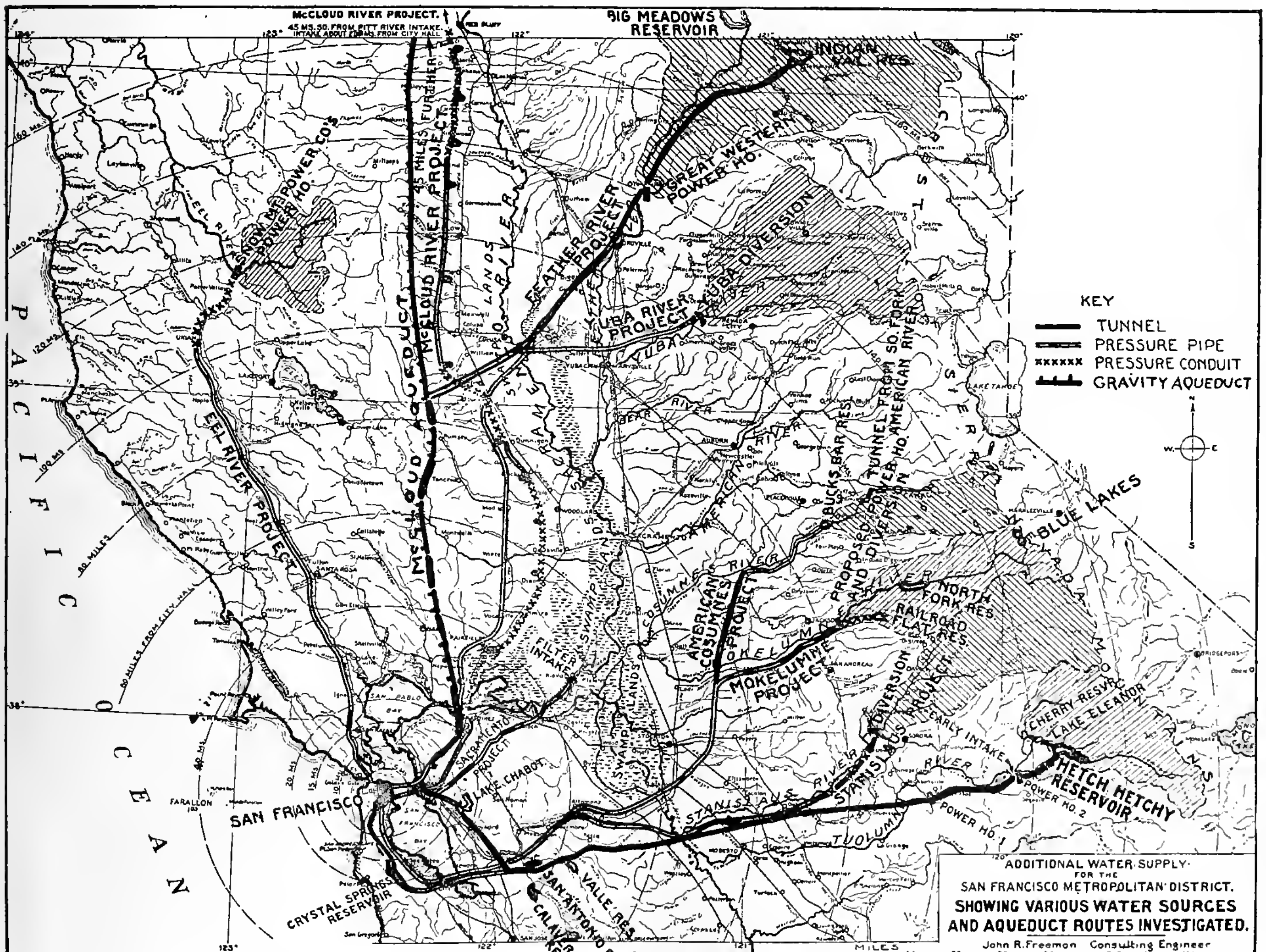
VOLUME XXIX | SAN FRANCISCO, DECEMBER 28, 1912 | NUMBER 26

SAN FRANCISCO'S PROPOSED WATER SUPPLY

BY RUDOLPH W. VAN NORDEN.
Member A. S. C. E., A. I. E. E.

The problem of a supply of water for use in the city of San Francisco to augment or replace the present supply and provide for a future increased demand as the population shall increase has intermittently confronted the people of that city like the fireballs discharged from a roman candle. Lurid presentments of the question have been followed by lulls as the problem has seemed to be settled, only to have a new phase presented, to end in a final splurge which dies in a chaos of darkness. It would seem that final stand on the question has now arrived, and it is to be hoped that some definite movement may be taken in which prejudices, private interests and half-truths may be swept away by a clear and broad understanding of the subject, enabling the immediate solution of a really big and far-reaching problem, in a manner which will at once be good engineering practice, serve the highest utilitarian end and produce the fairest treatment to all.



A Map of the Many Proposed Water Sources for San Francisco.

The holding in suspense by the Secretary of the Interior his final decision is full of meaning. It is beyond question to believe that any motive could permeate this action aside from the desire to attain the greatest welfare for all concerned, and it is with the greatest anticipated interest that many people look forward to the report and decision to be rendered by the United States Advisory Board of Army Engineers who have made a study into the Hetch Hetchy source of supply, as well as the many other sources apparently available.

The hearing before the Secretary of the Interior, Hon. Walter A. Fisher, is reported to have been interesting in many ways, but entirely unsatisfactory both from the point of view of the city and also to the Secretary. This matter had been delayed for consideration by the Secretary of the Interior upon the proviso that the city of San Francisco make a study of all of the projects which have been offered for a municipal water supply. It was directed last spring that reports on the various projects be presented to the board of United States Army Engineers to enlighten the Secretary upon the various merits and objections to all projects presented. The Secretary desired this information to enable him to judge as to whether the Hetch Hetchy source was the only feasible one available, in which case he would be justified in issuing the desired permit, notwithstanding the various objections which have been brought against the project.

In compliance with this request by the Secretary of the Interior the city of San Francisco, already committed to the development of the Hetch Hetchy project, employed a board of advisory experts to make careful and complete reports upon all projects presented. Notably among this corps of experts was Mr. John R. Freeman, a well-known hydraulic engineer of Providence, R. I., who, having been previously in the employment of the city of San Francisco, worked out an entirely new plan for the development of the Hetch Hetchy project to the full capacity of the watershed, and to provide for a future consumption not only for San Francisco, but also the east bay cities. His report embraced the entire collection of reports hitherto presented to the city.

These reports were recently officially presented to the United States Advisory Board of Army Engineers, and it was on the basis of the showing made that the hearing at Washington was held.

The official transcript of testimony of the hearing has not as yet been made public, except for extra typewritten copies which were made for the Spring Valley Water Company and for the city of San Francisco, the two most interested parties at the hearing. San Francisco was represented by James Rolph, mayor; M. M. O'Shaughnessy, city engineer; Percy Long, city attorney; T. S. English, assistant city attorney; Thomas E. Havens, assistant city attorney; James Phelan, ex-mayor, and the following engineering experts: J. H. Dockweiler, John R. Freeman, Cyril Williams, Allan Hazen, Prof. George Whipple, of the Massachusetts Institute of Technology, Desmond Fitzgerald, chief engineer of the Boston Water Works, and George Fuller, filtration expert.

The Spring Valley Water Company was represented by their veteran consulting engineer, Hermann Schussler, E. J. McCutcheon, attorney, F. C. Hermann, chief engineer, and George Anderson, the well-known consulting engineer of Denver. The Turlock and Modesto irrigation districts, who are the principal objectors to the use of water from the Tuolumne, were represented by Luther Waggoner and Henry T. Cory, both well-known consulting engineers. The Modesto district was further represented by its engineer, Burton Smith, and its attorney, B. H. Griffin. The Turlock district was further represented by Mr. H. S. Crowe, its engineer, and Mr. Jones, attorney.

The Sierra and Blue Lakes Water Company, one of the alternative projects offered to the city, was represented by a local Washington attorney.

The McCloud Aqueduct Company, who have presented an alternative project, was represented by Mr. A. L. Shinn, an attorney of Sacramento and San Francisco.

The nature-lovers, those who object to the use of the Hetch-Hetchy Valley as a reservoir from esthetic reasons, were the editor of the Century Magazine, Mr. Geo. Macfarlane, of Chicago, president of the American Civic Association; Prof. William Frederick Bade, of the Sierra Club, and one or two others.

The army board was represented by Colonel Biddle, Major Crosby, Colonel Taylor and its secretary, Mr. Wadsworth. Secretary Fisher had the following advisory board of engineers: General W. L. Marshall, consulting engineer to the Secretary of the Interior; M. O. Leighton, head of the water resources branch, United States Geological Survey; Otis H. Smith, director United States Geological Survey; F. H. Newell, director United States Reclamation Service; Mr. Marshall geographer United States Geological Survey; Dr. Rupert Blue, head of the United States Marine Medical Corps.

The hearing consisted largely of the city's representation of the Hetch Hetchy project and was interspersed with many questions by the Secretary. After the testimony was all taken the Secretary expressed himself as not satisfied with the showing on possible alternative projects, and intimated that the San Francisco representatives were pleading a cause rather than stating full impartial facts covering all phases of the question, as he had requested. In view of this situation, the Secretary asked that further information and data covering alternative projects be immediately presented to the advisory board of Army Engineers, to enable that board to make its report and recommendations to the Secretary. A time limit expiring December 23d, was given for the filing of this information, and it was intimated that if this was properly complied with a final decision might be speedily reached in the withdrawal of objections to the continuation of the Garfield permit and the additional permit for the use of the Hetch Hetchy Valley.

Brief History of Municipal Water Supply.

The history of this water question is unique. It has covered a period of forty years, and the many phases which have been presented, the maze of complications of every sort and hue, the false scents and

decoys, efforts at exploitation by promoters of various projects, mountainous objections which turned out to be molehills and insidious shadows, which have stealthily grown into stone wall obstructions, half-truths or absolute misstatements; many indeed presenting a kaleidoscopic curtain to obscure the true solution of the problem.

The first attempt at a water supply for San Francisco was made by the Mountain Lake Water Company in 1851. It was proposed to use a small lake at the west boundary of the Presidio Reservation, and take the water from Lobos Creek, through which the water from Mountain Lake passed into the outer entrance of the Golden Gate. Six years later the San Francisco Water Works was organized, and the water from Lobos Creek was brought around the northern part of the city by tunnel and flume to Black Point, whence it was pumped to various reservoirs. The Spring Valley Water Works commenced operations by using the water from a spring at Mason and Washington streets in 1858. In 1862 this company, having been strengthened financially, brought water to the amount of two million gallons per day from Pilarcitos Creek, in San Mateo County. The old San Francisco Water Works was purchased by the Spring Valley Water Works, later known as the Spring Valley Water Company, in 1865. In 1867 a series of litigations were commenced with the city, which have continued in a greater or lesser degree ever since.

In 1876-7 Lake Merced, which lies southwest of the city, near the ocean, was introduced into the system, and development was commenced on the famous Crystal Springs dam, in San Mateo County. This dam was sixteen years in construction. A period of low water, threatening a water famine, resulted in the introduction of the Alameda Creek supply in 1886-8. This was brought across the bay from Dumbarton Point in two sixteen-inch submerged pipes. These were supplemented in 1901 by two twenty-two-inch pipes, and artesian wells were developed in the Pleasanton Valley. This brought the supply up to about 35,000,000 gallons per day.

The Middle Falls of the McCloud River.
(These waters are being urged as a possible source of water supply for San Francisco.)

The city of San Francisco began to make investigations for a municipal water supply as early as 1870, following a season of unusually low water. On April 10, 1871, a committee was appointed by the Board of Supervisors to make a report. This committee consulted General B. S. Alexander, Corps of Engineers, U. S. A., and Prof. Geo. Davidson, United States Coast Survey, who made a report on December 11, 1871, as follows:

"That the water sources of the peninsula within reasonable distance are amply sufficient to furnish an abundant supply of good, pure, fresh water to provide

for the wants of San Francisco for at least fifty years."

It is interesting to note in this connection that only fifteen years after this date the Spring Valley Water Company introduced water from Alameda County. The years 1872-3, threatening a water famine, revived the subject of municipal ownership and a new water supply. This resulted in an investigation and surveys of the Blue Lakes, in the Sierra Nevadas, Clear Lake, Calaveras Creek, in Alameda County, and other peninsula sources, with a resulting report and a recommendation favoring the acquisition by the city of Calaveras Creek. While the city was negotiating for this purchase the Spring Valley Water Company, alive to its opportunities, stepped in and purchased the rights to the use of this water. This site has never been developed, and is advanced by the Spring Valley Company as a very large additional resource to increase the capacity of its system, suitable for a supply for many years to come. In 1876-7 another dry season prompted another set of investigations and surveys under the direction of Colonel Geo. H. Mendell, Corps Engineers, U. S. A., embracing the sources which had been suggested up to that time. This examination covered the Spring Valley sources, Clear Lake, Lake Tahoe, El Dorado Water and Deep Gravel Mining Company's properties, on the south fork of the American River.; Blue Lakes, in the Mekolumne watershed; Rubicon River, a tributary to the south fork of the middle fork of the American River; the San Joaquin, the Feather River and Lake Merced. In this year the Spring Valley Water Company offered its properties to the city for $16,000,000. A counter offer by the city of $11,000,000 was rejected.

The question of municipal ownership died down, due to abundant water seasons, and the additional development of water sources by the Spring Valley Water Company, until the dry season of 1897-8.

On January 8, 1900, the new city charter went into effect in San Francisco, and in accordance with its provisions an exhaustive study of the whole water situation was commenced. This study embraced the sources examined by Colonel Mendell in 1877, with the addition of investigations on the Yuba River, Feather River, Sacramento River, Eel River, Stanislaus River, Tuolumne River, Bay Shore Gravels, and the Bay Cities Water Company's resources. The result of this investigation by the board of public works and city engineer was a report finding the Tuolumne River, using the Hetch Hetchy and various other tributary reservoir sites as by far the most satisfactory source for a municipal water supply from every point of view. Abundance, purity, greatest storage, freedom from adverse water rights and large power possibilities.

Water location filings were made in July, 1901, at the outlet of the Hetch Hetchy Valley, on the Tuolumne River and at Lake Eleanor, on Eleanor Creek, in the name of James D. Phelan, then mayor of San Francisco. Refilings were made in 1908 at these points to comply with amended plans for development. Application was made to the Secretary of the Interior for the right to build reservoirs and occupy United States land for a canal line. These rights were denied by the Secretary on January 20, 1903. The Secretary granted a rehearing and again denied the rights on December 22nd of the same year, but with the recommendation that an appeal be made to Congress, he claiming that the law of October 1st, 1901, did not authorize such a grant. At this time strong opposition was put forward to the granting of these rights by the Spring Valley Water Company, and also by representatives of the Modesto and Turlock irrigation districts, who claimed that the taking of the waters for the supply of San Francisco would interfere with the development of these irrigation districts.

A bill was then drafted and introduced in Congress and was there referred to the Committee on Public Lands, from which apparently no action was gained. The matter was finally presented to the President in February, 1905, who in turn referred the matter to the Secretary of Commerce and Labor, who denied the recommendation, but from different reasons from those taken by the Secretary of the Interior. On July 27, 1905, a new and elaborate statement and argument for San Francisco was placed before the President, but before this came to his attention, while passing through the office of the President's secretary, was sidetracked, and turned over to the Secretary of the Interior. This error was subsequently rectified and the matter was referred to the Attorney-General.

On October 28, 1905, the Attorney-General rendered an opinion, in which he advised the President, quoting the law of February 15, 1901, to authorize the Secretary of the Interior to permit the use of rights of way through public lands and the various national parks, including the Yosemite, in which these rights are situated, for the purpose of supplying water for domestic, public and beneficial use.

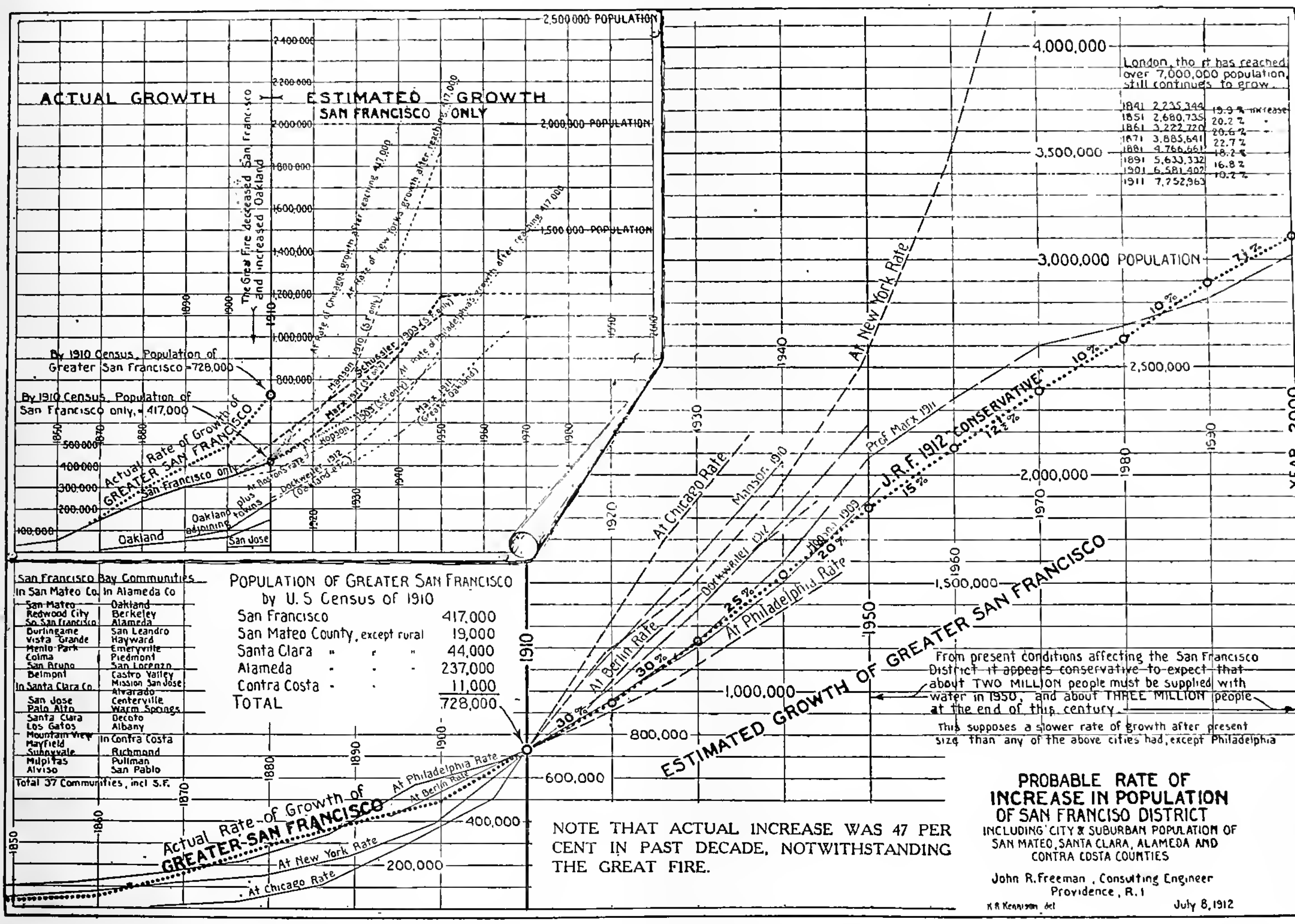
Pending these various applications for these rights the city engineer, who at that time was Mr. C. E. Grunsky, caused the Tuolumne project to be surveyed for a gravity canal, tunnels and pressure pipe lines across the San Joaquin Valley. This work was done in 1902, and an elaborate report, accompanied by maps and cost estimates, was made to the city of San Francisco. This furnishes much of the data which were subsequently used in the various plans for the development of this project. This survey did not commence at the reservoir sites, but from an intake somewhat lower down the river, but included two power plants, which utilized drops in the canal line. Subsequent surveys were made of the reservoir sites and alternative lines, by the city.

In 1906 the desired permit having not as yet been received, the Board of Supervisors of San Francisco passed a resolution enabling the city to proceed with the development of a project. About this time a New York promoter offered the supply known as the El Dorado Deep Gravel and Water Company's property, on the south fork of the American River. It included taking of water from Lake Tahoe through a tunnel under the summit of the Sierra Nevada Mountains. This offer proposed to sell to the city and conduct thereto water from this system for $35,000,000. There were a number of objections, which seeemed so evident that the offer was not seriously considered.

In this year the Bay Cities Water Company, which had already submitted a proposition to supply water from the Lower Santa Clara Valley, made a proposition

embracing the south fork of the American River and rights, reservoirs and canals, on the Consumnes River. This proposition was very well worked up and presented, and undoubtedly had some merits in its favor. The objections found were the difficulty in maintaining the watershed sufficiently free from contamination, the quantity of water, which was considerably less than it was proposed to eventually bring from the Tuolumne sources and the cost of construction of an order of excellence, which was considered necessary to maintain the purity of the water.

After this amended plan had been worked out by Mr. Manson to a degree sufficient to show to the people the immediate possibility of development and it had been decided to proceed with the work the new Secretary of the Interior, Richard A. Ballinger, after listening to representations of the various interests opposed to the project, served notice on the city to show cause why the permit issued by his predecessor should not be revoked. To meet this requirement the city has from time to time asked for extensions to properly present its case.



Probable Population Increase of San Francisco and Surrounding District.

Another objection to this source was the fact that there was use in the watersheds for this water for irrigation in the San Joaquin Valley.

From this time until 1908 there was very little done by the city on the water question until the Secretary of the Interior, James R. Garfield, granted the permit to use Lake Eleanor and the Cherry Creek Valley as reservoirs. The city engineer, who was at this time Mr. Marsden Manson, immediately set at work to change the project as worked out by Mr. Grunsky to utilize Cherry Creek and Lake Eleanor reservoirs and a suitable canal system, which might be readily enlarged as the need for water increased. The purpose of this plan was to delay the development of the Hetch Hetchy reservoir until the future need of San Francisco would become so important as to justify a further permit for its use.

The Garfield permit was issued May 11, 1908.

The history of this action and the publicity which was given throughout the country is so recent and well known by all that it will not be further commented on. Secretary Ballinger was succeeded in office by the present Secretary of the Interior, Walter A. Fisher, with whom the matter of renewing the permit issued by Secretary Garfield was immediately taken up by the city. The city of San Francisco had already voted a bond issue of $40,000,000 for the construction of the project, and had also voted money to pay for the water rights in Lake Eleanor and Cherry Valley, which was given over in two payments, the last of which was made in 1911, amounting to $1,000,000. These rights and properties which were acquired by condemnation proceedings and not by open purchase as has been recently stated, have been known as the "Ham Hall purchase." In 1911 Secretary Fisher, desiring to settle the question of San

Francisco's water supply in a manner of strictest equality to all concerned, and without fear or favor, requested of Marsden Manson, who at that time was still city engineer, that reports be made on all feasible projects for the purpose of determining whether or not there might be a more suitable project than the Hetch Hetchy, or one which would be equally suitable and without the strenuous objections which had been dur-

The Hetch Hetchy Valley as It Is Today.

ing the last six years levied against the Hetch Hetchy project. The result of this order on the part of the Secretary were reports, which have been already mentioned, on the Stanislaus, American, Eel, Mokelumne, Feather, Sacramento and McCloud Rivers, and included a variant on Grunsky's plan for the early utilization of Cherry Creek and Lake Eleanor, and which included the designs for modern power development by Mr. A. M. Hunt and the writer. Through various causes, more especially the illness of Mr. Manson, this presentation was delayed, and in the spring of 1912 Mr. John R. Freeman was employed to make a new study of the Hetch-Hetchy system, with the object, if possible, of overcoming all objections, and at the same time giving a more comprehensive exploitation of the subject, together with a study of the reports on the other sources which had been presented. This report is the one which has been recently presented to the advisory board of Army Engineers, and which, while it has brought out a refinement of the Hetch Hetchy problem, has also served indirectly to bring out the points of excellence and disadvantages of the various other projects. It, however, has gone further than this; for while it shows in a masterly way the possibility of development of one of the greatest water supply systems in the world, it has also served to increase the objection by the opponents of the project to the use of the water, and has pointed out a method of developing other systems which may be equally as good and possibly cheaper, without interfering with conflicting rights or privileges. The Honorable Secretary now demands further and more complete data on the alternative projects.

The company supplying the city has been obliged to buffet the powerful tide of public sentiment and from time to time has apparently had uphill work in holding its business against municipal encroachment. But whatever may have been its wrongs, fancied or real, whatever may have been the quality of its product and its service, it must be admitted that it has developed its system to keep abreast of the demand when it was predicted that it could not. Its works are permanent and thoroughly constructed; it has maintained the quality of water at the highest point possible, considering the nature of the supply, and it has made a game fight. It has stockholders and bondholders who have invested in good faith. The injustice of ruthlessly throwing out this system, as so many have advocated, would probably be a difficult undertaking, for reasons both legal and technical, which will become more apparent as the water situation becomes more fully understood. As a matter of fact, no system has been proposed which has not suggested or included the use and co-operation of the Spring Valley system.

The better government of the city, that which within the last decade has stood for better civic ideals and the true welfare of the commonwealth, has caused the name of Hetch Hetchy to be a by-word in the mouth of every citizen, as emblematic of the great hydraulic emancipation which will make San Francisco the most-talked-of great city in the world, so far as her water supply is concerned.

The people of San Francisco know that there is crystal pure water in the mountains of the Sierra Nevada from the northern limit to far south, and they know that from somewhere this water may be brought. The people expect and will accept nothing else—it must be the crystal clear mountain water, and they have been taught to believe that from no other source may this supply be found in greater purity than the Tuolumne, and the Tuolumne's great storage site is the Hetch Hetchy Valley.

The difficulty of bringing water from the Sierra Nevada, as a problem in engineering has grown less and less as the years during which this plan of water

The Beautiful Hetch Hetchy Valley as It Will Appear
With Scenic Roads When Submerged.

supply has been considered have passed. Other metropolitan centers have embraced the benefits of engineering skill and daring, and have succeeded in constructing works fully as intricate and stupendous as the problem which confronts San Francisco, and which have been as successful and as beneficial as San Francisco expects it to be.

After much money has been spent, engineers and lawyers have been consulted, years of work in the field

and in the municipal affairs, the people, the newspapers, the city's officers, all are educated and believe, all are centered on the one desire to obtain this great supply of water. Is there any reason, then, that with such a concensus of opinion the United States Government should block such a worthy use? If there is a reason, the people want to know it. The people as a whole are fair and just. If they are wrong, if they need further enlightenment, they are ready and willing to learn. But they will not give up cherished ideals without something better than that which put the ideal there.

In the case of Hetch Hetchy there has been a more or less concerted movement on the part of a few nature-lovers to prevent the issuing of a permit to flood the valley from what they believed to be esthetic reasons. San Francisco's need is one to be blocked only by reasons of equivalent or greater weight. The nature-lovers' objection, beside being a mistaken one, is of no weight against San Francisco's need. It has been amply discussed elsewhere. It does not, on its face value, enter the question here. As a matter of fact, few people, aside from what they read from time to time in the newspapers, and these articles are seldom accurate, or give a true view of the situation, have anything but the vaguest conception of the problem or its status at any time, and this holds true even to technical men, whose interest for engineering problems keep them alert for new things.

The Freeman Plan for the Development of the Hetch Hetchy Water.

Mr. Freeman was authorized to make a report which would analyze the situation from start to finish. The Secretary, on presentation of a petition signed by the mayor and advisory water commission, on May 13, 1912, granted an extension of time until July 15 to file additional and complete data and to permit objectors to the use of the Hetch Hetchy to present their views with respect thereto.

Mr. Freeman was familiar with the ground to be covered, and had, in fact, put much thought on the proper solution of the problem, and was further convinced that the Hetch Hetchy supply would not only fill every requirement that San Francisco and all the bay cities might have in the next one hundred years, but he also became convinced that the methods of development which had been thentofore adopted, while satisfactory for a small or partial development, were not suitable either from an economic point of view or from one of permanency and the proper protection of the flow with a more comprehensive plan which he had evolved. After a final careful study of every phase of the situation in the spring of the present year, it was decided to make his report embrace the new plan. This report of nearly 400 pages, quarto size, is a most elaborate and exhaustive treatise covering the subject from the hygienic and sanitary, as well as the engineering side. It is profusely illustrated with views of dams and reservoirs of many noted systems in different parts of the world. Route maps and profiles are shown in whole and in detail in a most thorough manner. Throughout the estimates of cost, with profuse references are brought out in a most lucid manner, and the results are startling in showing what can be done in the very substantial manner prescribed with the many trying conditions to overcome.

To the main report there are twenty appendices, compiled, with four exceptions, either by engineers working in conjunction with Mr. Freeman or by independent engineers. These appendices, in their order, are on the following subjects:

1. Municipal Progress Report for Co-operation in Water Supply.
2. An Act to Provide for the Incorporation, Organization and Management of Municipal Water Districts.
3. Present Resources Supplying Oakland, Alameda, Berkeley, etc.
4. Dependable Additional Supply from Alameda Creek, By John B. Freeman.
5. Abstract of a Report on Underground Supply. By J. H. Dockweiler.
6. Doctrine of Percolating Waters. By Percy Long.
7. Inadequacy of Spring Valley Supply. By H. A. Noble.
8. Basis for Estimate of Capacity and Cost of Hetch Hetchy Project Aqueduct and Tunnels. By John R. Freeman.
9. Preliminary Estimate of Cost of Hetch Hetchy Project. By Horace Ropes, in consultation with John R. Freeman.
10. Cost Estimate of Stanislaus River Project. By C. E. Grunsky.
11. The American-Cosumnes Project. Abstract from report of J. H. Dockweiler.
12. Report of Filtered Supply from Sacramento River. By Allen Hazen.
13. A Proposal to Furnish Water from the McCloud River. Comment by C. E. Grunsky; notes by C. E. Grunsky Jr. and John R. Freeman.
14. Eel River as a Source of Water. By C. E. Grunsky.
15. Feather River Investigation. By C. E. Grunsky and N. A. Eckart.
16. Yuba River as a Source of Supply. By C. E. Grunsky.
17. Abstract of a Report on Turlock-Modesto Irrigation Districts. By J. H. Dockweiler.
18. The Mokelumne River as a Source for San Francisco. By C. E. Grunsky.
19. Tuolumne River Gaugings.
20. Report on Properties of Spring Valley Water Company. By J. H. Dockweiler.

It is apparent from the discussions reported from the recent hearing that the appendices covering projects antagonistic or alternative to the Hetch Hetchy project have not been satisfactorily presented, either through lack of detail, insufficient information, or conjecture not based on facts.

In their present shape they bear out the long held contention of San Francisco that no other project could be substituted for the Hetch Hetchy. This was brought out by the Secretary who is quoted as intimating to the San Francisco delegation that they were pleading a cause and not offering an unbiased solution of the problem by giving for the decision of the Honorable Secretary a complete exposition of every claim.

Original Plans of Development.

In both the Grunsky and Manson plans of 1902 and 1910-11 it was proposed to divert the flow of the Tuolumne River about seven miles in the latter instance and fifteen miles in the former, below the Hetch Hetchy Valley, carry the flow in open canal along the

mountainside, except for occasional tunnels, but utilizing a gravity flow. In the earlier plan there was to be a drop and power plant in Bear Gulch, and a second plant at a drop near Dry Creek. The Hetch Hetchy dam was to be built to a height of 150 ft. and dams in Cherry Creek and Lake Eleanor (a natural lake, but of little value without a dam to increase the depth) to a height of 150 ft. In the Manson plan it was proposed to develop the two smaller lakes first, having the permit for these only, from the Department of the Interior. It was proposed to take the combined flow from these lakes in an open canal to North Mountain, on the north bank of the Tuolumne, about seven miles below the Hetch Hetchy Valley outlet, and there dropping to the river, develop power. It was also intended to take the natural flow, diverted by means of a low dam sufficient to make the diversion at the Hetch Hetchy outlet, carry this along the south bank of the river in an open canal and drop through the same power house, as the Eleanor-Cherry water. The water was to be again diverted into a canal which would drop the water taken from the main river higher up, through a power station situated at the junction of the south fork with the main river, this flow being returned to the river to supply the irrigation districts below. The equivalent of the Eleanor-Cherry flow was then continued in canal and tunnels to Bear Gulch, where it was to be dropped through the third power house and from here it was to be continued in gravity canal and tunnel with some sections of pressure pipe to Dry Creek, where it was again dropped through the fourth power house. From this point the water was to be taken into two 50 in. pipes, a distance of 62 miles, across the San Joaquin Valley to a pumping station to be operated by power transmitted from the power plants. Here the water was to be pumped to an elevation of 675.5 ft., from whence it was carried through a long tunnel and then pipes, through the Livermore Valley, thence through the Alameda hills, across the Bay of San Francisco and then up the peninsula to the city. This plan contemplated the delivery of 60,000,000 gallons daily to San Francisco and ultimately of about 300,000,000 gallons, when completed to full capacity.

The Freeman report contemplates a development on a broader scale and it was with three cardinal points in view that this plan was developed. He realized that the water necessity would in time be as great on the east side of the bay as the west and that eventually a metropolitan district would be formed. The total consumption of water on the San Francisco peninsula is now nearly 40,000,000 gallons per day and could be greater, while that of Oakland, Berkeley and Alameda is over 27,000,000 gallons per day. With the rapid growth of population down the peninsula and on the east side, the bringing in of 60,000,000 gallons, together with present sources, unless they be developed further, would soon be met. He has calculated that in 25 or 30 years, at least 200,000,000 gallons daily will be required and that in 100 years, this will be more than doubled, besides developing the present supply reserve sources to the utmost. The plan therefor contemplated an ultimate supply to require all of the available storage and he estimated this to be 400,000,000 gallons daily. The next important consideration was the absolute retention of the purity of the water found in the high mountains,—the partial object of going so high up. Pipe and tunnel offered the most permanent solution of retaining the flow at all times without contact with the open air or any other source of contamination and to prevent chemical action and lower the friction factor, these must be smoothly lined with concrete. The third important consideration was, by maintaining the line under pressure for practically the entire distance, to make possible the flow from the force of gravity alone, without resorting, as in the previous plans, to pumping. The power which it is still proposed to generate is to be used for municipal purposes.

It is proposed to build all tunnels of a capacity to carry the entire future flow of 400,000,000 gallons daily; but, for the present, the pipe lines which are eventually to be in duplicate will carry about one-half this amount, while the final section of pipe from the connection to Crystal Springs reservoir into San Francisco will have a capacity of but one-eighth, or 50,000,000 gallons, and a like amount, when desired, into the Crystal Springs reservoir. For this latter amount it is not necessary to build a high dam in Hetch Hetchy valley, but only one of about 150 ft. in height, about as originally proposed by Grunsky. It is not proposed to build either the Cherry or Eleanor dams at present. It is for so much of the development that the cost was found to be about $37,000,000.

As the demand increases, it is proposed to drive a tunnel from the conduit to Lake Chabot which supplies the Oakland system, or to run a line of pipe directly to Oakland.

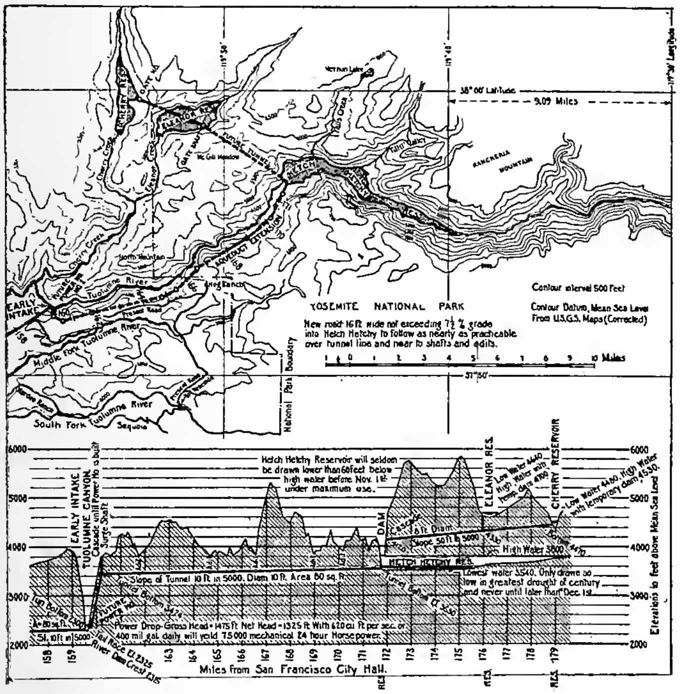
When the demand reaches one-half of the capacity projected or, possibly, a maximum of 240,000,000 gallons, it will have been necessary to build low dams, 50 ft. in height in both Eleanor and Cherry Creek, giving a total storage of 65,300,000,000 gallons. For the complete development, it will be necessary to build the dam in the Hetch Hetchy Valley to a height of 300 ft., making a storage of 110,000,000,000 gallons, and build the Cherry and Eleanor dams to their full height, and also to build a dam in the Poopenout Valley 250 ft. high to store 17,000,000,000 gallons. This will bring the total cost of the project according to a summation of Mr. Freeman's figures to about $75,000,000, not including the cost of the Spring Valley system which is intimately worked into the Freeman plan.

The plan contemplates diverting the water at first at Early intake, about 12 miles below the Hetch-Hetchy Valley, into a tunnel which, with one interruption, where the south fork is crossed, is carried to Moccosin Creek (this is further west than Bear Gulch.) Here a drop is made and the water will eventually pass through a power plant. From here it enters a tunnel, crosses the Tuolumne in a steel pipe line, thence through a tunnel to Dry Creek. From this point the San Joaquin Valley is crossed by two pipe lines (eventually) and these are carried up the west side to a surge tank at the hydraulic grade. Thence passing through a series of tunnels and pipe siphons to the Irvington gate house. From here pipes carry the water across San Francisco Bay and up to the

Crystal Springs reservoir, or on an alternative plan, directly to San Francisco delivering into the proposed San Miguel or the University Mound reservoirs. The Oakland flow is taken as already stated.

It is not proposed to construct the first 12 miles of the conduit unless it should be found that, flowing in the river bed is contaminating, or until the second power plant is built, which will be placed at the Early intake.

Upon the development of the Cherry-Eleanor reservoirs it is proposed to bring their waters into the Hetch-Hetchy reservoir through an unlined pressure tunnel which will pass through a mountain of solid granite. At the foot of this tunnel will be located the third power plant.



Inlet of Proposed Hetch Hetchy Project.

The amount of power which can be developed by this system is large, amounting to over 150,000 h.p. It should be remembered, however, that this amount of power cannot be generated until the full flow of the conduit shall have been established or until the entire storage capacity is developed. This of course might be many years in the future. With the flow of 50 to 100 million gallons daily, power would be only proportional and comparable with the amount proposed to be developed in the earlier plans.

It is interesting to note in this connection that in at least two of the alternative possibilities, the Indian Valley (Feather River) and the McCloud, a large amount of power may be developed immediately, whether the water be carried to the bay cities in full quantity or not.

Objections Raised Against Hetch-Hetchy Project.

With all other desired points feasible and possible, the principal objectors to the use of the Tuolumne water are the irrigationists who depend on the river for their water, the Spring Valley Water Company, who, unless their system be purchased would be liable to lose a large part of their business, holders of conflicting rights, and the proponents of alternative projects. No attempt will be made here to treat with the latter three, but the former situation is vitally imporant and forms the basis for the entire discussion.

Modesto and Turlock Irrigation Districts.

These irrigation districts lie to the south and to the north of the Tuolumne River, respectively, and get their water supply from a common diversion at La Grange. Here is the highest overflow dam in the world and one of the most famous. The amount of land now under irrigation is about 130,000 acres, but the amount possible to irrigate in the districts and which must depend upon this water supply is 258,000 acres. In addition to this there are lands outside of the districts which if they are ever developed, must get water from the Tuolumne River and cannot get it from any other source. This brings the total acreage to 460,000. It has been claimed by Mr. Freeman and others that the land now irrigated has been and is being over-irrigated. While this is probably the case, it must be remembered that practically no water or very much less than is needed is delivered through the months of July, August and September. In order then to properly irrigate, there must be provided storage and it is this feature that the U. S. Reclamation Service is carrying out in many parts of the country and undoubtedly would be interested in doing here. Intricate reports and calculations have been made as to the adequacy of the source to supply both the irrigation districts from the natural flow and some storage and the San Francisco supply from the flood storage. The question asked in all fairness by the irrigators, that seems to be overlooked is this: "If the highest use of this water is to provide not only for present needs of a metropolitan district but for 100 years to come, should not the ultimate development of the lands which are bound to be populated in time be also provided for?"

A casual perusal of the tables of yearly run-off shown in U. S. Water Supply paper No. 299, pp. 267,-270, shows, in a five-year period from October, 1895, to October, 1900, an average of 1,590,000 acre ft. of water, the maximum being 2,440,000 acre ft. and the minimum 960,000 acre ft. Taking, however, the three-year period from 1897 to 1900 the average is less, being 1,310,000 acre ft. The outside maximum storage capacity in the watershed is calculated to be 700,000 acre ft., which cannot store over 75 per cent of the run-off.

A study of the Turlock-Modesto lands by several irrigation experts has shown that to properly irrigate the soil a depth of 3½ ft. of water gross per year is necessary. On the assumption that this is correct, the amount of water necessary for the land irrigated at present, for the entire district and for the total area which must get water from this source is as follows:

130,000 acres now irrigated, 455,000 acre ft.

258,000 acres in the combined districts, 905,000 acre ft.

460,000 acres, all lands subservient, 1,610,000 acre ft.

A continuous flow to San Francisco of 400,000,000 gallons per day is equivalent to 448,900 acre ft. per year. It is immediately seen by inspection that if all the lands are to be fully irrigated there would on this average, be no water for San Francisco and in

some years not nearly enough for irrigation. There is always a possibility that the official stream gaugings do not account for much water in maximum flood conditions, but this is conjecture. The above is the sort of plain argument that frightens the irrigationists.

At the recent hearing, the attorney for the districts is reported to have stated that no objection would be raised to the storage and use of flood waters by San Francisco, provided San Francisco would sell to the districts at a price to cover the cost of storage, sufficient water during the low period of flow, for their needs. This is reported to have been agreed to by the San Francisco representatives, until such time as the city should need the water. Such an agreement could not be accepted. The question therefor gets back to the starting point, can San Francisco get water, equally as well elsewhere, or if not, is its need a preference over that of irrigation which cannot be had in any other manner?

There are at least two adverse claims for the use of the Tuolumne water for power purposes and for which the Hon. Secretary has been applied to for permits. Undoubtedly these must receive consideration and might have better claim to the use of the water, for power only, than San Francisco.

Alternative Projects.

Some of the alternative projects notably the filtration of Sacramento River water the Indian Valley (Feather River) and the McCloud aqueduct, more especially the latter, are reported to have received considerable consideration in the recent hearing. The remaining projects were apparently not seriously considered, as on the face, they were assumed to lack the desirable features to be found either in the Hetch Hetchy or the above named alternatives.

Mr. Freeman has grouped the projects in two groups. Those whose water can be brought to San Francisco in a conduit across the upper end or around the head of San Francisco Bay, and those which must perforce, cross both the Sacramento River and the Bay of San Francisco between Oakland and that city.

The Stanislaus River Supply.

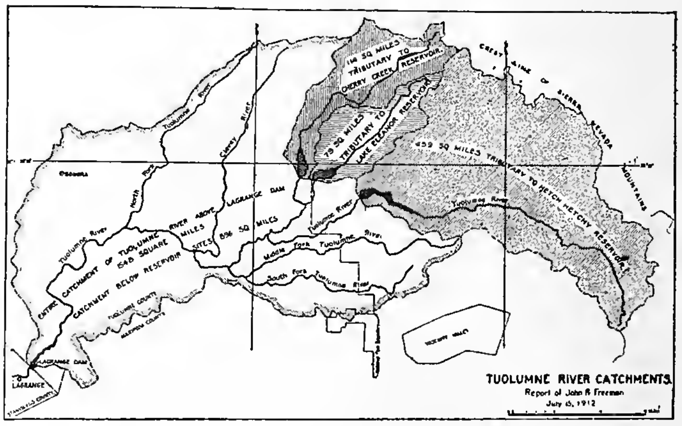
This belongs to the first of the groups and would be very similar in its conduit to the Hetch Hetchy, the Stanislaus being the next watershed to the north of the Tuolumne. Appendix No. 10 by Mr. C. E. Grunsky is a report on this project. This conceives a pipe and pumping system somewhat similar to the original Hetch-Hetchy plan. There is on this river the power plant of the Sierra & San Francisco Power Company who have developed one of the large reservoir sites. There are no other large reservoir sites and the catchment area of about 900 square miles is more or less inhabited. The quantity of water which might be delivered to San Francisco is estimated by Mr. Grunsky to be not over 60,000,000 gallons per day, and he cites a number of disadvantages, such as the quality of the water, conflicting uses and a very large territory which must eventually be irrigated from this watershed. The cost estimated for this system is $40,000,000. So far as the writer is informed, this report covers the subject satisfactorily.

The next river north of the Stanislaus is the Calaveras on which no project has been suggested for a water supply.

The Sierra-Blue Lakes Project.

This project has its source on all three branches of the Mokelumne River, the next north of the Consumnes. The proponents of this project have been insistent in their claims and have undoubtedly drawn much favorable attention to a consideration of the value of this source.

This project is described by Mr. Grunsky in a report given as Appendix 18 in the Freeman report. The plan of development contemplates the use of the existing Blue Lakes on the south and middle fork watershed and the construction of new reservoirs on the middle and north fork. Of these the Railroad Flat site, is the most important. The proponents of this project have made strong claims to compare favorably with the Hetch-Hetchy, but Mr. Grunsky, in his report finds considerably less capacity than is claimed, for the reservoirs. Outside of the connection between



Drainage Area for Hetch Hetchy Scheme.

the reservoirs, the conduit line would in a general way be similar to the older Hetch Hetchy plan, and according to Mr. Grunsky would require pumping to get over the Altamont hills, although a gravity system is also suggested. There is a large amount of land amounting to about 200,000 acres dependent upon this watershed for irrigation which forms a factor of objection, fully as great as the one confronting the Tuolumne sources. On the north fork the natural flow has been in use by the Pacific Gas & Electric Company to furnish power for their Electra system. Mr. Grunsky finds that a daily supply of 60,000,000 gallons could be developed and that this might be increased to 200,000,000 gallons. The cost given for the former development is $30,700,000, and for the latter $78,600,000. From point of cost given this project will not compare favorably with the Hetch-Hetchy. As to quality of water and adverse claims a more thorough study of the situation will in all probability have to be made. Sufficient power may be developed to do all necessary pumping with some reserve. The proponents offered to bring this water to the east side of San Francisco Bay for $20,000,000, a sum which is probably much too small.

American-Consumnes Project.

This project was well exploited in 1906-7 and was close to receiving favorable consideration from the city. It proposed to take water from the south fork of the American and connect this with the Consumnes, the river which lies to the south of the American and next north of the Mokelumne. This project was ad-

vanced by the Bay Cities Water Company and an abstract of a report for present uses is included in Appendix No. 11 by Mr. J. H. Dockweiler. This report is exhaustive and the conclusions are, that for the delivery through a system, substantially similar to the earlier Hetch-Hetchy plan, 60,000,000 gallons daily could be developed for the sum of $36,800,000, and that an all gravity conduit, requiring no pumping, similar to the Freeman plan for the Hetch-Hetchy would cost, for the delivery of 220,000,000 gallons the sum of $69,200,000. There is a large amount of land dependent upon this source for irrigation, amounting to 658,500 acres, but it is found that this may be irrigated and still find sufficient water by storage for the city supply as outlined. This project has received the most thorough engineering study of any of the alternatives, except perhaps the Sacramento River filtration, but due to its greater cost and limit to the supply, seems to have not been given great consideration recently.

Yuba River Sources.

The Yuba River which lies next north of the American drains a large watershed and has three main branches. The south contains many reservoir sites, part of which are developed and is owned largely by the Pacific Gas & Electric Company. It is on this fork of the Yuba that the new Lake Spaulding dam is being built. This dam, designed by the late Mr. James Wise, in consultation with Mr. Frank Baum, will be one of the highest in the world, is for the purpose of storing water to be used for a series of large power developments and for extensive irrigation.

The north fork of the Yuba offers by far the greatest volume of low water flow as well as total runoff but has few reservoir sites. It, at one time, was seriously considered as a supply for San Francisco by the formation of a large reservoir at Oregon House. The use of the water by the Pacific Gas & Electric Company's Colgate plant precludes the consideration of this source.

Between the middle and the south fork are a number of storage reservoirs built in the early days of the state for mining purposes. These reservoirs are owned by interests allied with the Spring Valley Water Company and form the basis of supply which that company has offered in connection with its other supplies in case it should be found necessary to reach to the Sierra for an additional source. This supply should be equally as good as the Hetch-Hetchy or any other in quality. The writer knows of no basis of comparison as to cost or quantity although it seems probable that the former would be somewhat greater and the latter less than the Hetch-Hetchy. No irrigation rights of any moment would be interfered with and a large amount of power could be developed.

Feather River Source.

The Feather River is the next watershed north of the Yuba and is the largest in area and in quantity of flow of any of the rivers so far named. It has four main branches and several lesser ones of considerable importance. Local interests hold the south and middle forks, and no supply proposition is known to have been projected from these sources. The north fork is the largest in point of flow and watershed and contains at least two reservoir sites of unusual value and great capacity. These sites are the Big Meadows which is being developed as the second largest reservoir in the world, by the Great Western Power Company, and Indian Valley. The latter site was examined and surveyed by the U. S. Reclamation Service in August-September, 1905. The watershed is large, covering about 733 square miles and is a wild uninhabited region. Water stored in this reservoir would have all of the purity and desirable features to be found in any of the high Sierra sources. The problem, in its general form would be like the projects already described, but this project and also the Yuba would fall in the second classification given by Mr. Freeman. It will be necessary to cross both the Sacramento River and San Francisco Bay. Indian Valley is in the Diamond Mountain Forest Reserve, but the inundated portion is patented land to the amount of probably 6000 acres which would have to be purchased. While measurements show an annual discharge much in excess of the amount to be eventually used by the city, storage would at times lessen the flow in the North Fork, thus interfering with the operation of the Great Western Company's plant at Big Bend. This company is said to be the only adverse claimant either for power or irrigation rights and in all probability an arrangement could be entered into with them to supply the power, which probably could be developed to the amount of 150,000 h.p. to them, and having them deliver over their system to San Francisco, this power, less an amount to pay for transmission and also to make up what is lost by storing water. This is the suggestion of Mr. Henry T. Cory and is undoubtedly worthy of consideration. He further proposes in crossing the Sacramento Valley in order to shorten as much as possible the line of pressure pipe to go directly to the west side and then follow the proposed gravity line of the McCloud aqueduct to San Francisco. This line of conduit would be somewhere between 200 and 220 miles in length supplying both Oakland and Berkeley and San Francisco and in any event only from 5 to 10 per cent longer than the conduit in the Freeman plan to supply both cities. No figures of cost have as yet been made but the idea is sufficiently attractive to receive some attention.

The report on the Feather River project given as Appendix 15 in the Freeman report is well described by a remark made by one who attended the Washington hearing, "A straw man set up to fall of its own weight." This report presupposes a diversion of water below the Big Bend power station and at an elevation of about 400 ft. This should be sufficient to condemn the project without the trouble of carrying the report further. Water taken at this point would of necessity have to be filtered and would probably never be accepted by the people of San Francisco under any condition. This report carries out an estimate of cost of a gravity project with a filtration system. The sum given for a supply of 60,000,000 gallons daily is $42,250,000; for 200,000,000 gallons, $92,008,000; and for 400,000,000 gallons, $171,819,000. No power could, of course, be developed, in fact this plan would be almost similar to the Sacramento filtration plan with the disadvantage of added distance and the benefit of

gravity flow. Further discussion is a waste of good space.

The McCloud River Source.

There are no rivers available in point of quantity flow or storage possibility to the north of the Feather until the McCloud is reached. The Pitt River, which should be called the main Sacramento, has immense flow and great storage possibilities, but the quality, where the diversion would have to be made, is not sufficiently pure to use without filtration.

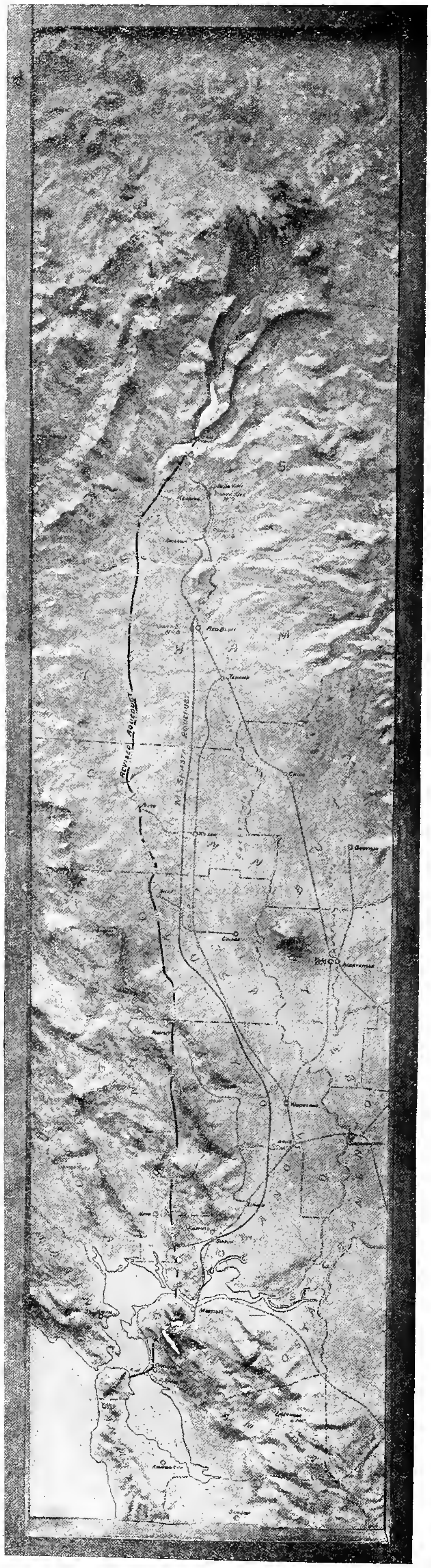
The McCloud has its source largely in the snowy slopes on the eastern and southeastern side of Mt. Shasta. The watershed covers an area of about 675 square miles and is included in the Shasta National Forest Reserve. About 70 per cent of this area is patented land and much of the territory is heavily timbered.

The nature of the ground surface is porous due to volcanic formations, and the run-off passes into the ground only to emerge in many beautiful springs to form by their cascades, the McCloud River. The purity and quality of this water is described by Mr. Freeman in his notes in Appendix 13 of his report. Probably in no source in California could the water be purer or less liable to contamination.

In the presentation of this project another "straw man," this time, wet straw, seems to have been set up. But the weakness of the presentation seems to have drawn the attention of the Hon. Secretary to its coyly hidden possibilities. The objections which have been offered were: the great distance; the possibility of contamination from lumber camps; the greater cost; the taking of water necessary for irrigation and the lack of power development possibility on the line of conduit.

The proponents of this project made a survey during 1911 from the point of diversion to Suisun, or practically the point where the conduit would follow the Hazen plan of filtration of Sacramento River water to San Francisco. This survey contemplated a pressure pipe line and gravity conduit down the Sacramento Valley and the development of enough power on the line of aqueduct to pump the water into Oakland and San Francisco. This survey was probably as accurate and thorough as any survey made by the city. When the Freeman plan for bringing Hetch-Hetchy water was developed doing away with the need of pumping, a similar plan was conceived by the McCloud proponents and it was discovered that by constructing a high line canal, water could be conveyed by gravity in open cut covered aqueduct, similar in all respects with the Los Angeles Aqueduct, and thus carried to the bay cities, the only pressure lines being under the straits of Carquinez and the bay of San Francisco. This new line, while there has not been time for a complete survey, has had a careful reconnoissance and the data available is probably as accurate as that used by the city in developing the new plan from Hetch-Hetchy, which does not follow the original surveys.

This line after crossing the Pitt River, passes through a tunnel and crosses the Sacramento River above Redding. It then follows the contour of the west slope of the Sacramento Valley, mostly in gravity concrete lined and covered conduit, to a point west



The McCloud Project as Proposed.

of Williams. From here a tunnel carries it to the Capay Valley and after following this valley for several miles another tunnel takes the conduit to the Berryessa Valley, thence by another tunnel to the eastern slope of the Napa Valley, thence to Carquinez straits. Crossing the straits in a pressure tunnel, the hydraulic grade is again assumed and the conduit terminates in the proposed Pinole and San Pablo reservoirs. From these a pressure tunnel and pipes carry the water to Oakland and San Francisco. The low cost of this project in comparison with all of the others, including the Hetch Hetchy is due to the large amount of gravity flow canal, and the relatively smaller amount of tunnel and pressure pipe.

The length of this aqueduct from the diversion to San Francsico, including the supply for the east bay cities, is about 216 miles, or 16 miles longer than the Hetch-Hetchy aqueduct for the same purpose. In casual reference to this project people have figured the railroad distance from San Francisco to Pitt, which figures to 280 miles, which has probably given rise to the idea of great distance. The proponents of the project either own or have options on 98 per cent of the patented lands which include the lumber camps. The acquisition of this area by the city gives immediate control to habitation and sanitation. The remaining two per cent consists of a game preserve and the summer homes of a few persons, two of whom, at least, are most respected citizens of the metropolitan water district.

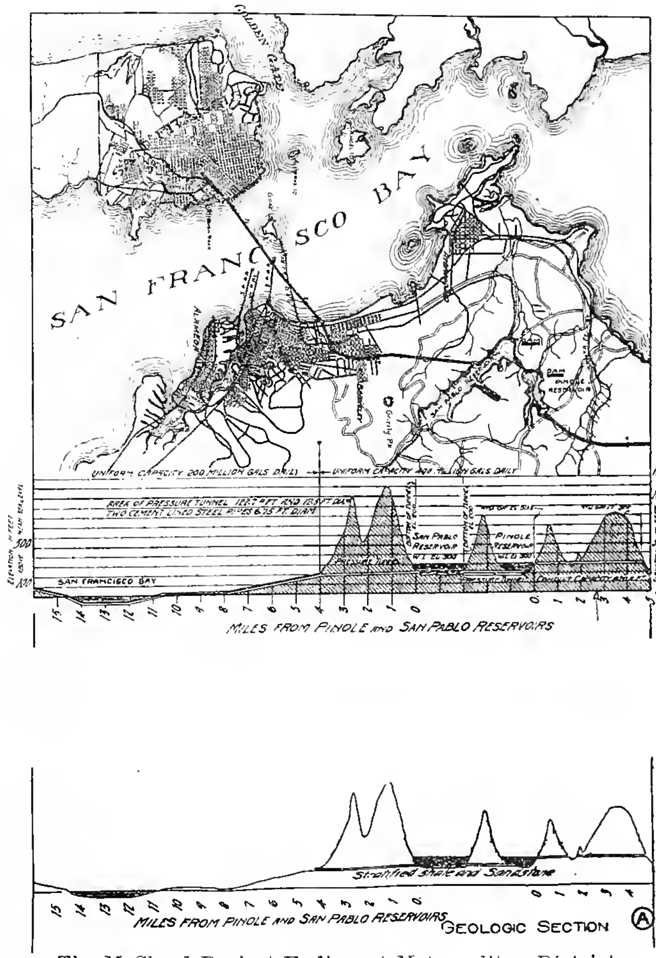
The cost of this project, including all rights and lands, has been estimated by the writer, on the unit cost basis adopted in the Freeman report, and is, for a full development of 400,000,000 gallons, delivered to San Francisco and east bay cities, $54,624,560, which is $20,000,000 less than the summary of costs given in the Freeman report for the Hetch Hetchy system fully developed. A preliminary development for one-half of the water delivery or 200,000,000 gallons, would cost about $45,000,000, or very nearly the figure recently given out by Mr. Freeman as for a like amount from Hetch Hetchy.

This project has the disadvantage of a bay crossing, but a service line down the east side could readily be made to connect with the Spring Valley's lines. This would, of course, apply to all of the more northerly group of projects.

The U. S. Reclamation Service has calculated that the entire available supply from rivers emptying into the San Joaquin Valley would be sufficient to cover all of the irrigable land of that valley about twenty inches in depth, while the same calculation concerning the Sacramento Valley would cover the irrigable land to a depth of about nine feet (5th annual report U.S.R.S.) The rivers of the east side of the Sacramento Valley will probably supply for all time all the water necessary to irrigate land east of the Sacramento River. Those of the west side will partially irrigate the irrigable land of the west side. The use of 400,000,000 gallons by the city would probably decrease the volume of the Sacramento River at the head of irrigation not more than ten per cent, during the low water period. This still leaves enough water at the lowest period to irrigate all lands in the valley, leaving a large surplus in the river.

In the development of this project the municipal water district might by some manner be extended to take in Red Bluff, Sacramento, all of the west side towns, Santa Rosa, Napa, Vallejo, etc., and deliver water to all of these towns under heavy pressure.

So far as the city supply is concerned no storage is necessary as the minimum flow of the McCloud is about twice the amount which it is proposed to use. No power can be developed on the line of the aqueduct, but within the watershed about 120,000 horsepower may be developed immediately.



The McCloud Project Ending at Metropolitan District.

Sacramento River Filtration Project.

This project which has been ably reported by Mr. Allan Hazen and forms Appendix 12 in the Freeman Report contemplates pumping from the Sacramento River near Rio Vista with an auxiliary pumping station at Antioch, carrying the conduit through the Contra Costa hills, through Oakland, thence across the Bay to San Francisco. An alternative line passes southward and around the head of the bay to avoid the crossing. The project includes a very complete modern filtering plant.

The necessity of going so far for the water is to ensure the procuring of fresh water, the fresh water zone having a variation of about 35 miles. This conduit from the pumps to San Francisco would have a length of 51 miles. It is proposed to develop at first with a nominal capacity of 75,000,000 gallons daily. The cost of this installation is summed up for 75,000,000 gallons, $24,000,000; for 120,000,000 gallons, $42,000,000; and for 180,000,000 gallons, $60,000,000. These figures are not made on the basis of the Hetch

Hetchy figures and may be higher in comparison. From them is however seen that for the full supply necessary, any of the gravity systems would be cheaper. Further than this it is doubtful if the people as a whole would ever accept a filtered supply if a mountain source could be had. It is interesting to note in this connection that many experts favor this plan and claim that the water will be most satisfactory. In the recent hearing, Dr. Rupert Blue, than whom no higher sanitary authority probably lives, is reported to have made the statement, "That he would rather have Sacramento River water filtered than Hetch Hetchy unfiltered."

Throughout the period of planning by the city for a water supply the Spring Valley Company has stoutly proclaimed its ability to develop its resources and furnish water to the amount of 252,000,000 gallons daily to take care of the needs of the city for many years to come, besides a Sierra source. The company, through Mr. Schussler and its corps of engineers, have made thorough studies of their problem and have conducted campaigns of education before the people. Both the engineering and legal features have been thoroughly exploited by independent engineers and lawyers and the results from both sides do not always seem to coincide. The matter has been in fact, so freely and thoroughly discussed that there will be no attempt to do so here. This phase of the question is, however, one of importance and will have great weight in the final decision.

READINESS TO SERVE METHODS

ELECTRIC POWER ON THE FARM.

BY ROSS B. MATEER.

The average farmer works perhaps longer hours for a living derived from the cultivation of the soil than the man engaged in any other form of labor. He rises hours before the sun shows above the horizon and does not complete the feeding of his cattle and the chores around the house until long after the sun has set, knowing that each day throughout the year the daily routine must be performed repeatedly with little or no variation.

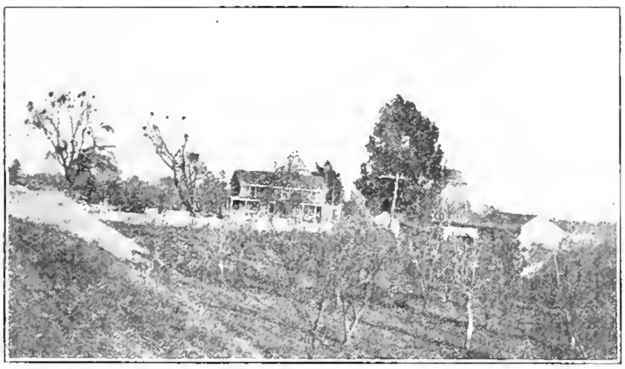


Fig. 1. The Typical Rural Cottage—A Fruitful Field for the Power Salesman.

Cheerfully he enters into a contract with nature, knowing that the results of his labor are certain under proper climatic conditions, and that he will enjoy the perfect health with which to perform faithfully his part in forcing from the soil, the products that may be utilized as a medium of exchange or be readily converted into gold or silver.

A certain acreage is secured by a small payment and the balance covered by a mortgage on the land, the productiveness of which depends greatly upon the ease with which it yields to scientific principles of cultivation.

Grain, requiring little or no attention in its growth, is frequently that which first appeals to the farmer; grass for cattle and hay for winter feed are necessities and must be grown and cured in quantities sufficient to last an entire year. The hay must be baled and stored in weather proof sheds, the wheat or barley harvested and threshed, the straw cut in many cases by manual labor, yet almost any process that must be repeatedly performed with little or no variation can be more successfully and economically accomplished by a motor-driven mechanical device than by any other means.

The electric motor, in small sizes, has ceased to be a luxury, having reached the stage of a necessity, and within a few years will be the agent by which the greater part of the routine work on the farm is performed.

Fig. 2. The Country Home on the Farm.

To commend itself to the farmer and his requirements, the electric motor must be economical primarily with reference to cost of operation; secondarily with reference to the space occupied and the safety and adaptability for all agricultural purposes.

A flexible cable with a plug attachment is all that is needed to connect the smaller sized units. They may readily be carried from one part of the building to another and can be easily belted to any machine, thereby providing a satisfactory combination of speeds by the use of pulleys of various sizes. When the motor is too large to carry, it may be mounted on a truck and readily drawn from the barn or woodshed to the field, where, by means of a flexible cable and connection to a convenient pole, it will operate the threshing machine. In fact, the electric motor can be located in

almost any portion of the farm, or in any building, where current is available and can be started or stopped merely by the turning of a switch. It may be placed safely with reference to convenience of the work and with little regard to the source of power.

Small individual motors are adapted to a multitude of small machines and where many are to be in use at one time and are located in one building, a satisfactory grouping results in the operation of only one or two portable units.

Fig. 3. Orchard, Tank and House to Be Electrically Supplied.

Some of the principal applications of motors on the farm consist of house pumps, corn shellers, fodder cutters, threshing machines, corn dividers, elevators, horse and sheep clipping and all dairy and household uses, resulting in safety to the operator and economy to the owner.

Operating Costs.

The question of vital importance to every farmer is not what is the investment necessary that he may increase his earning capacity and secure larger returns from his labor, but rather, what is the operating cost. How much will it cost him to pump water for his cattle and for domestic purposes? What is the cost of threshing grain? How will a motor save time and money?

To give a careful estimate of the cost, an investigation was necessary. Data available from various sources indicate that from 5 to 6 gallons of water per member is consumed; for cattle from 12 to 15 gallons per head; for swine, 1 to 3 gallons, from which the average daily consumption of water is easily determined, so that knowing the total quantity, the unit cost per thousand gallons is apparent. To pump 1000 gals. to a tank, 35 ft. in elevation, approximately one-half of a kilowatt hour is required, which, at the average rural rate of three cents per kilowatt hour, is one and one-half cents.

A threshing machine is capable of threshing, cleaning and sacking from 100 to 200 bushels in a day of ten hours and may be operated on a five horsepower motor. The larger the capacity of the machine, the greater the motor horsepower required. A machine of 800 bushels requiring a twenty horsepower motor.

The consumption in kilowatt hours per hundred bushels of grain was determined from a series of tests to be 25 kw. for rye; 22 for wheat; 19 for oats; 21 (kilowatts) for barley.

A machine with a capacity of 145 bushels per hour, operating on a 15 h.p. motor, required 0.1257 kw.-hr. per bushel and cost, including labor, interest and depreciation, $0.00377 per bushel.

Fodder cutters of a capacity of two tons per hour and operated by a motor of ten (10) horsepower, require 2.08 kw.-hr. per ton while those requiring only from one to two horsepower, consume as low as 1/4 kw.-hr. per ton.

Grinding of ear corn will require 0.411 kw.-hr. per bushel, while for shelling corn 0.0448 per bushel is required.

A horse groomer easily operated in the barn, only records a consumption of 0.106 kw.-hr. per horse, or cost only $0.00318.

All the above cited examples tend to confirm the representations of the salesman who is not only earnestly seeking to interest the farmer in the use of motor operated, current consuming applications of power, but also to convince him that merely by the turning of a switch, he may economize in the monthly payroll by using less manual labor, thereby allowing him to awake in the morning and find the glorious light of another day instead of darkness meeting his opening eyes.

SWISS HYDROELECTRIC POWER DEVELOPMENT.

The past 15 years have witnessed a remarkable advance in hydroelectric power development in Switzerland. What may be called the pioneer hydroelectric plant in the Confederation was established in 1863 at Schaffhausen, on the Rhine River. The old system of cable transmission was used, and it was not until 1901 that modern electrical appliances were installed. The first plant built along up-to-date lines for hydroelectric power generation was located at Heerbrugg, in the Canton of St. Gall, and has been in operation since 1887.

Since this latter date hydraulic stations for the production of electrical energy have sprung into existence in all parts of the country, following the rapidly increasing use of electricity and the demand for cheaper power. In 1911 there were 783 electric power plants in operation in Switzerland. Of this number 473 were works which purchase power from other plants and simply resell the same, generating no energy themselves. Of the establishments producing their own power 233 were wholly or partly hydroelectric stations, and only the remaining 77 were steam cr gas plants.

GIGANTIC ELECTRIFICATION IN RUSSIA.

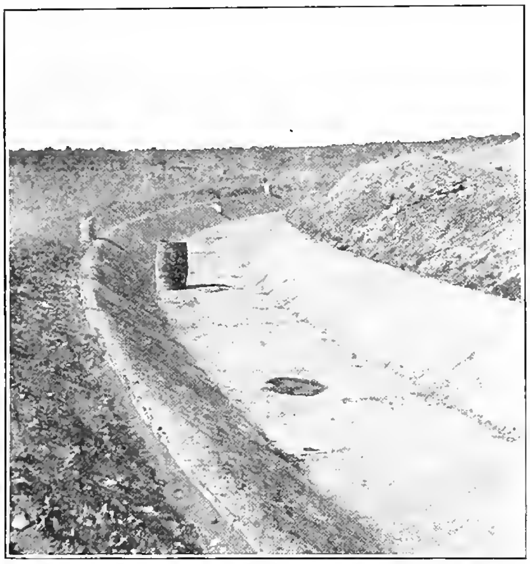
The six principal Russian banks in concert with a powerful Belgian group, have obtained imperial sanction, for the company to be formed for utilizing the water power in Finland, including the Lesser Jmatra and three other falls, as well as the Russian fall on the Volkhov River, to supply electrical energy to St. Petersburg and environs. The scheme comprises not only lighting and power for the city and suburban industries, but for extensive undertakings like the circular electric railway round St. Petersburg and the electrification of the existing railways for suburban traffic.

ELECTRICAL PUMPING AND IRRIGATION

ECONOMY OF CONCRETE LININGS.

BY B. A. ETCHEVERRY.

While concrete linings have many advantages, it is not an economical proposition to line canals indiscriminately without considering all the factors upon which a decision should be based. The problem resolves itself into a comparison between the cost

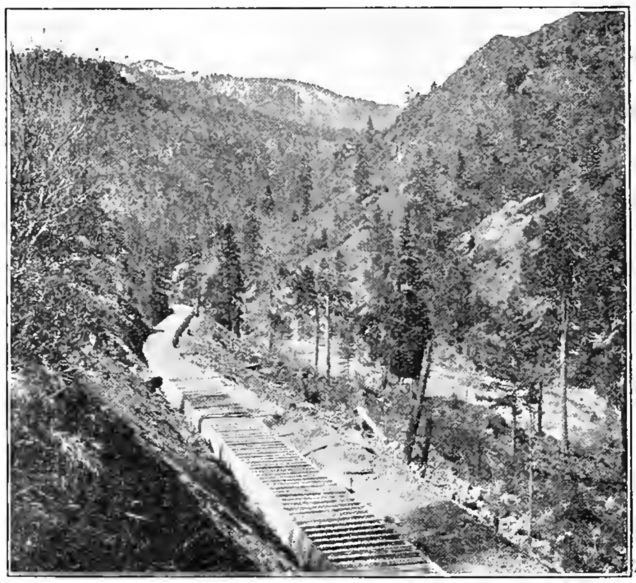


Condition of Lining Before Application of Mortar Wash, Burbank Irrigation and Power Co., Washington.

and the benefits derived. The factors which must be considered are (1) cost of construction, (2) cost of maintenance and operation, (3) damages due to waterlogging and alkali, and (4) value of water loss.

When a new canal is to be constructed the choice between an unlined canal and a concrete lined canal will depend largely on the first cost of construction. When there is sufficient fall available, a concrete lined canal can be given a steeper grade than an unlined canal which could not resist the erosion due to high velocity. The steep grade and also the smoother cross section will give a high velocity which will make the necessary size of the canal much smaller. The concrete lined ditch can also be given steeper side slopes which will decrease the excavation. For these reasons the amount of excavation, especially on side hill work, will be much smaller for the concrete lined canal than for the unlined canal, and this will reduce the cost of excavation sufficiently to balance for at least a part of the cost of lining, and in some cases where the excavation is in hard material, the concrete lined canal may cost less than an unlined canal. Where there is not sufficient fall available to give the lined canal a steep grade, the comparison will not be quite as favorable but even then a lined canal because of its smooth bed and sides will have a greater velocity than an unlined canal on the same grade, and therefore a smaller cross section, and on side hill work in hard material the saving in cost of excavation will be considerable. Other benefits which must be considered are the decreased cost of maintenance and operation ,and the greater safety. There are no weeds to contend with, no breaks to mend and consequently the cost of patrolling is eliminated. To this must be added the value of the water saved and the prevention of waterlogging of the land below a leaky ditch. These benefits can not be closely estimated when a new canal is to be constructed but should be considered before deciding the feasibility of a concrete lining.

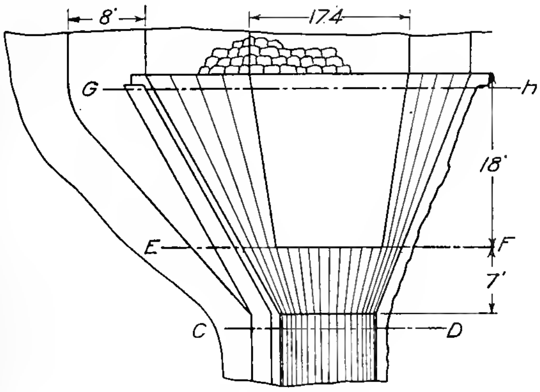
With existing canals the problem is to prevent the seepage losses, or to increase carrying capacity by either enlarging the canal or by lining it with concrete. The extent of the seepage losses can be obtained by measurements, the damages done to adjacent land below and the maintenance of the canal are fairly well known and will furnish sufficient data to estimate what can reasonably be spent in concrete lining. When the capacity of the canal must be increased, the choice is between making a larger unlined canal or to use a lined canal of smaller cross section which will have a higher velocity because of the smoothness of the sides and bed. There are many cases where the value of the water loss alone will justify the improvement of the canals by lining. This is obtained when the value of the water loss will be equal to or larger than the depreciation and interest on the capital invested. As an illustration, if a canal carrying 50 cu. ft. per second throughout the irrigation season of 4 months or 120 days, loses 3 per cent per mile, which is not excessive, this loss is equal to a continuous flow of 1.5 cu. ft. per second or 3 acre



Canal Lined With Semi-Circular Reinforced Concrete Sections Joined in the Field, Tieton Canal, Washington.

ft. per day, which gives a total of 360 acre feet whose value at $1.50 an acre foot is $540. For this case we would be justified in spending per mile a capital the interest of which plus depreciation is equal to $540 If we assume interest and depreciation at 8 per cent, the capital is about $6000. In most cases this would

be more than enough to build a concrete lined canal of that carrying capacity, depending on the velocity which can be used.



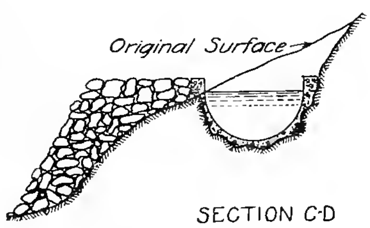
Junction of Canal With Flumes and Tunnels.

The assumed seepage loss of 3 per cent for a canal carrying 50 cu. ft. per second is often exceeded with small canals, and on most irrigation systems there are always some sections of canals which would warrant concrete lining. A general formula which gives the thickness of lining justifiable for different conditions is the following: Where

$$t = \frac{sQv}{16.3\ pci}$$

t = thickness of lining in inches.
s = the rate of loss by seepage, per cent of flow per mile.
Q = flow in canal in cubic feet per second.
v = value of 1 cu. ft. per second per annum.
p = length of perimeter to be lined, in feet.
i = rate of interest, depreciation and renewal.
c = cost of lining in place per cubic yard.

By transposing the terms the rate of seepage which will justify a given thickness t is $s = \frac{16.3\ ptci}{Qv}$



SECTION C-D
Semi-Circular Section.

With the increasing price of water and with the development of water by storage and pumping, which is almost always expensive, the time will soon come when many of our irrigation canals will be concrete lined.

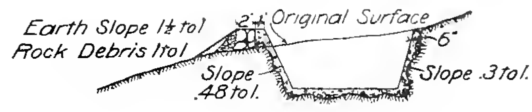
Change of Canal, Cross Sections or Junction of Canals With Flumes, Tunnels, Etc.

In irrigation work it is often necessary to change the cross section of canals and to increase or decrease the velocity. The following cases often occur:

1st. To pass from one material to another which will stand a higher velocity.
2nd. To pass from an unlined section to a lined section.
3rd. To pass from a canal to a flume, tunnel, culvert, etc.

The transition can be made by introducing the proper difference in elevation to change the velocity and by changing the section by one of the following manners:

1st. By maintaining a constant side slope, using for the transition either the side slope of the lined section or the side slope of the earth canal or an intermediate side slope.
2nd. By warping the surface, which is usually the preferable method if not too difficult to construct.
3rd. By vertical wings placed on an acute angle to direction of flow.



SECTION E-F
Intermediate Change in Section.

For these problems the following formula is developed:
Let
H_t = total fall necessary to gain the required increased velocity and to overcome the friction and impact in the transition.
h_v = velocity head to gain increased velocity.
h_f = friction head.
h_i = loss of head due to impact.
s = grade of transition.
l = length of transition.
v_1 = velocity at upper end of transition.
v_2 = velocity at lower end of transition.

To simplify the problem the following approximation is made: Assume that the velocity changes uniformly from v_1 to v_2; use an average hydraulic radius for the transition which will be the hydraulic radius of the middle section of the transition and assume for the average Kutter's coefficient of the transition the coefficient obtained for the middle section for the grade S.
H_2 = gain in elevation obtained at the outlet when passing from a higher velocity to a lower velocity.

$$v_m = \frac{v_1 + v_2}{2} = \text{mean velocity of transition.}$$

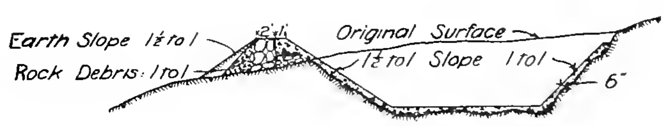
C_m = mean Kutter's coefficient for transition.
r_m = hydraulic radius of section at middle of transition.

$$h_v = \frac{(v_2)^2}{2g} - \frac{(v_1)^2}{2g}; \quad v_m = C_m \sqrt{r_m s}; \text{ but } s = \frac{h_f}{l}$$

Therefore

$$v_m = C_m \sqrt{r_m \frac{h_f}{l}}; \quad h_f = \frac{(v_m)^2\, l}{(C_m)^2\, r_m}$$

In addition to the velocity head and friction there is more or less loss of head due to impact. This loss of head due to impact may be expressed by an equation of the folowing form: $h_i = c\left(\frac{(v_2)^2 - (v_1)^2}{2g}\right)$, where c is a co-



SECTION G-H
Final Change From Tunnel to Ditch.

efficient which will depend on the length and form of the transition; it will probably not exceed .25 and may be considerably less for a good transition; .25 may be taken as a safe value.

The total fall necessary at the inlet is then:

$$H_t = h_v + h_f + h_i = \frac{(v_2)^2 - (v_1)^2}{2g} + \frac{(v_m)^2\, l}{(C_m)^2\, r_m} + .25\, \frac{(V_2)^2 - (V_1)^2}{2g}$$

or

$$H_1 = 1.25 \frac{(v_2)^2 - (v_1)^2}{2g} + \frac{(v_m)^2 l}{(C_m)^2 r_m}$$

The gain in elevation obtained at the outlet is then:

$$H_2 = h_v - h_f - h_i = \frac{(v_2)^2 - (v_1)^2}{2g} - \frac{(v_m)^2 l}{(C_m)^2 r_m} - .25 \frac{(v_2)^2 - (v_1)^2}{2g}$$

On the Umatilla project in Oregon gaugings were made in a semi-circular concrete lined conduit and the following results were obtained in the inlet transition from the canal in earth to the concrete lined section. The concrete lined conduit is 9.8 ft. in diameter and has a maximum carrying capacity of about 300 second ft. The earth canal has a bottom width of 17.4 ft., a depth of 7.5 ft. and side slopes of 1 :1 on one side, and 1½ : 1 on the other. The transition consists of warped surfaces 25 ft. long. The concrete lined channel has a total length of 2.085 ft. and a number of sharp curves including a double reverse curve with 100 ft., 50 ft. and 50 ft. radius. When the gauging was made the volume carried was 205 second ft. and considering the channel as a whole the mean depth of water was 3.95 ft., mean area of the water cross section 28.47 sq. ft., the hydraulic radius 2:11 ft., the velocity 7.20 ft. per second and n = .0146. The earth section had a depth of water of 4.3 ft. and a velocity of 2 ft. With this data the computations for the transition are:

$$H_1 = 1.25 \frac{(7.20)^2 - (2.0)^2}{64.4} + \frac{(v_m)^2 l}{(C_m)^2 r_m}; \text{ but } v_m = \frac{7.20 + 2.0}{2} = 4.6$$

$$l = 25; \quad C_m = \frac{117 + 77}{2} = 97; \quad r_m = \frac{2.11 + 3.13}{2} = 2.62$$

$$H_1 = 1.25 \frac{(7.20)^2 - (2.0)^2}{64.4} + \frac{(4.6)^2 \times 25}{(97)^2 \times 2.62} = .93 + .0213 = .9513 \text{ ft.}$$

The loss of head actually measured was .95 ft. which checks very closely with the above computations. The loss of head due to friction in the transition itself is very small and practically negligible in any case. The loss of head due to impact is considerable, amounting in this case to about $.25 \frac{(v_2)^2 - (v_1)^2}{2g}$ or .185 ft. This shows the necessity for using longer transitions where the loss of head is a detriment. A transition of sufficient length to give an increase or decrease in average width of canal section of 3 ft. for every 10 ft. in length would probably decrease the coefficient of impact to about .15.

WIRELESS TELEPHONE HEARD THIRTY-FIVE MILES.

Assistant Professor G. W. Pierce, of Harvard, in co-operation with John Hays Hammond Jr., the well-known inventive scientist, conducted a series of experiments by wireless telephone at the latter's laboratory at Gloucester, recently, with excellent results. The two experimenters got into communication with the Harvaard Wireless Club and talked with its members for fully fifteen minutes. Cambridge and Gloucester are thirty-five miles apart and this makes the experiment all the more wonderful.

SYNOPSIS OF PROPOSED WORKMEN'S COMPENSATION LAW IN OREGON.

The members of the Oregon Commission were selected with the view that they would be fairly representative of the various interests of the state to be affected by the enactment of legislation of the character proposed. Three of the number are representatives of labor, three representatives of employers of labor, and three representing the taxpayers of the state.

The law which has been drafted covers substantially the same occupations as are affected by the Washington act.

The State of New York passed a compulsory act and its court of last resort, the Court of Appeals, unanimously held the act unconstitutional, both under the state constitution and the constitution of the United States. On the other hand, the Supreme Court of Washington sustained an act substantially identical, so far as constitutional objections were concerned, with the New York act.

No question of constitutionality can be seriously raised against an act which is elective in character, therefore the proposed enactment of a law is elective and not compulsory. All of the states other than New York and Washington which have adopted legislation of this character have enacted elective laws, and their constitutionality has been sustained in every instance.

So far as the employer is concerned, the act will doubtless be uniformly accepted, since it provides that in case the employer refuses to accept its terms he shall not be permitted to plead as a defense in any action brought by his injured workman that the injury was the result of contributory negligence, the negligence of a fellow servant, or that the injured person assumed the risk which resulted in his injury.

On the other hand, though the workman is entitled if he so desires, to reject the benefits of the act, its advantages to him are so certain and so obvious that his acceptance of its terms is practically assured.

The election by both the employer and the workman is required at the time the act becomes operative, or at the time the employment commences, and no election can be exercised after the happening of an accident. The act, if adopted, will become operative on July 1, 1913, and will affect all employers engaged in the hazardous occupations who do not affirmatively elect not to work under it at least fifteen days before that date and all workmen of such employers who do not affirmativeuy reject it before that date.

By mutual agreement between employers and workmen engaged in occupations other than those specially defined, the act may be made applicable to them.

The law proposed contemplates the creation of a State Industrial Commission composed of three members and charged with the administration of the act. This industrial commission receives the money payable under the act and deposits it with the state treasurer. Whenever a claim is allowed on account of death or such disability as entitles the claimant to receive an allowance by way of monthly installments for a period of two years or more, it becomes the duty of the state treasurer to set apart a sum sufficient in view of the life expectancy of the claimant, if the installments are to continue for life, or for the period fixed by the act,

if the allowance be for an injury, as will meet the monthly installments thereafter to fall due. Such funds so set apart are required to be invested in securities of the class authorized for the investment of funds by savings banks under the laws of this state, thus absolutely guaranteeing the payment of the installments.

The act contains a schedule of allowances for death, total permanent disability and various permanent partial disabilities, and invests the commission with authority to fix by reference to those specified the allowances for such partial disabilities the precise nature or extent of which it is impossible to foresee or to define.

The findings of the commission are made final on all questions of fact, the only right of review preserved being on questions of law involving a construction of the act.

An exception is made with respect to the payment of allowances in monthly installments to this extent: The commission is invested with authority in its discretion to pay over to a beneficiary who is or becomes a non-resident of the state a lump sum equal to three-fourths of the present value of future installments, and also to a resident beneficiary a sum not greater than one-fourth of the present value of future installments. In the first case mentioned the claim of the non-resident beneficiary is thereby extinguished, and in the second all subsequent monthly installments are proportionately reduced. The object of the first provision is to relieve the state of the expense of administration for the benefit of those in which it is not directly interested, and the object of the second provision is to make possible the exercise of a wise discretion by the commission where a substantial sum presently available may be useful in lifting an incumbrance from a home or establishing a beneficiary in some business which may aid in his support.

Under the Washington law in the event of a fatal accident to her husband, a widow receives until death or remarriage twenty dollars a month and an additional sum of $5 for each child under the age of 16 years, but in no event more than $35. By the proposed Oregon law a widow receives $25 a month and $6 for each child under 16, with a maximum allowance of $45.

Under the Washington law the maximum allowance for a permanent partial disability is a lump sum payment of $1500 for the loss of a right arm at or above the elbow. By the proposed Oregon law a person suffering this injury is entitled to $25 a month for 96 months (eight years). The present value of such a series of payments computed at 4 per cent is $2015.

The bill proposed also contains a feature of the most importance and which is not contained in the Washington act, namely, a provision for first aid and surgical treatment, and hospital accommodations. This provision authorizes the commission at an expense not greater than $250 in any one case to provide such first aid, together with transportation, medical and surgical attendance and hospital accommodations, and also authorizes the commission in its discretion to permit employers upon terms fixed by it and under its supervision to make such provision. It is believed that under this authority much suffering can be relieved and many lives saved.

The act provides that each employer subject to its terms shall each month retain from the wages of his workmen a sum equal to five-tenths of 1 per cent of such wages, and shall pay the amount so retained with his own contribution in a sum equal to six times such amount, or 3 per cent of his monthly payroll. To this amount shall be added by the state a sum equal to the amount contributed by the workmen. Such payments shall continue until the employer shall have contributed to the fund an amount equal to 3 per cent of his annual payroll computed by taking twelve times his current monthly payroll. If no accidents have occurred in his business, both he and his employes are then relieved from further payments, provided there are sufficient moneys in the fund to meet all demands upon it. Whenever payments are made from the fund on account of such employer's workmen his obligation to continue payments is revived until he once more reaches the point where his contributions, less payments for account of his men, equal the required 3 per cent of his annual payroll.

It is believed that this provision will work even-handed justice to all employers, whatever the comparative hazard of their business, and will place a premium on individual care which can be secured in no other way.

Provision is made for the prompt payment of the moneys due from the employer by denying him the benefits of the act for default in payment after demand. In such a case the injured workman has the option of suing his employer or of taking under the act, and if he elects to take under the act, the commission succeeds to the right of action against the employer, which the workman might have maintained.

In the interest of the workmen and the state it has been thought wise to preserve the effect of the statutory requirements with respect to maintaining safety appliances and devices. Therefore, the act provides that, if the commission shall determine that an injury has been caused by an employer's violation of the law in this regard, he shall be subject to suit at the election of the injured workman, unless such workman shall take under the act.

In order to insure to the full extent the purposes sought to be accomplished, the bill contains a provision exempting all moneys paid or payable under its terms from seizure for any debt of the beneficiary.

OREGON AGRICULTURAL COLLEGE USES ELECTRICAL APPLIANCES.

Manager Morton of the Oregon Power Company, Albany, Oregon, in his Weekly Letter of December 10th, says: "We are taking on some interesting business in the appliance line at the Oregon Agricultural College. In the agronomy department they are using a toaster stove for the baking of soils; in the bacteriological department they are using electricity for heating for germ incubation. We are also placing a flat square stove for other work. In the chemistry department we are working out some electric heating and in the poultry department they use electricity for electric incubators. This work is being done in connection with the electrical engineering department of the college. There is a very large field at the college for this business."

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POWER AND GAS

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NOTICE TO ADVERTISERS.

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

Entered as second-class matter at the San Francisco Post Office as "The Electrical Journal," July, 1895.
Entry changed to "The Journal of Electricity," September, 1895.
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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

New Agriculture and the Engineer

Victor Hugo truly said "Happy is the nation that has no annals." To apply this statment to a modern technical journal one should substitute "editor" for "nation" and "typographical errors" for "annals." This editorial was in last week's issue left most unfortunately suspended in midair. We conclude in the following lines the probable future relationship of the engineer and the new agriculture:

The immediate duty of the agriculturist under the proposed regime is, through research and education, to make the agriculture of California more prosperous. Through its various divisions, it must strain every nerve to solve the material problems, which beset those who create wealth from the soil. Picture the countless new industries that must, perforce, be brought to light. Dr. Eyde of Norway, a recent visitor to California, alone would demand 150,000 horsepower should be install his plant for the Birkelund-Eyde process of producing synthetic nitrogen fertilizers for the soil. Again, recent investigation emphasizes the fact that water can be lifted electrically, fifty feet vertical, cheaper than it can be made to flow by gravity through a canal five miles or over in length. Here, then, is a possible application of electrical power wherein many gravity installations may be abandoned due to the ingenuity of the electrical engineer. It takes little further imagination to picture the countless related engineering investigations that will inevitably follow. "Back-to-the-farm," then, must be the new call of the engineer, and he who would interpret the true meaning of this call, will do well to follow with his future investigations and activities largely in the wake of the agriculturist.

Proposed Power and Water Supply for San Francisco

When a city proposes to appropriate 400,000,000 gallons of water daily, or in other words, divert, 445,000 acre ft. of water annually from any particular water-shed, the entire commonwealth wherein this city is located, may well be concerned in the computations involved. The most recent report of the U. S. Geological Survey on the waters of California states that a total of 11,500,000 acre ft. is the average total drainage from the San Joaquin waters and that since 3,000,000 acre ft. are lost in the Tulare sink, only 8,500,000 acre ft. actually drain off toward San Francisco. In this self-same area is located over 7,000,000 acres of possible irrigable land. On the other hand, in the great Sacramento district to the north an average drainage of 20,000,000 acre ft. prevails and a total of 2,250,000 possible acres of irrigable lands are to be found. Hence at first sight it is seen that the San Joaquin Valley has not sufficient water at best for its ultimate development, while the Sacramento Valley drainage has more than ample to supply all possible needs.

If there is another possible source of water supply which computed upon a basis of discounted present value is comparable in cost, and quantity and quality of supply to the Hetch-Hetchy scheme, and if the Hetch-Hetchy scheme is found, from impartial investigation, to be a possible undue drain upon the Tuolumne basin, then by all means the city of San Francisco should turn in that direction regardless of the

former heavy expenditures. For it is not good business policy in a great commonwealth blessed in natural agricultural possibilities to allow a gigantic water scheme to waste its natural reclamation possibilities.

The investigation at Washington has brought out some facts worthy of further consideration. It developed at this hearing that the consulting engineer's estimates of costs upon the Hetch-Hetchy plan were computed upon a basis of labor at $2.25 per day and freight rates to be charged passing through the Panama Canal, while those of Consulting Engineer Hazen in estimating the filtering of the Sacramento waters were on a $3.10 per day basis and the freight charges those at present in force. The Secretary of the Interior has ordered a harmonizing of these computations in order to arrive at a basis of comparison.

Even on this revised basis of comparison, however, a just measure of actual cost differences can not be made. The only possible fair method would be on the basis of discounted "present value" of the different projects proposed. For instance, curves should be drawn showing a relationship, during the coming century, of estimated population and use of water at the varying periods. Interest, taxes, operating expenses and depreciation should all be proportionately taken care of. From such a curve, then, could be derived the actual average cost per annum for San Francisco. A system such as the Sacramento River filtering scheme which may be economically added to from time to time, as the needs arise, would appear in its true prospective by discounting the present value of a scheme such as the Hetch-Hetchy or the Indian Reservoir on the Feather River which must needs be almost completely developed from the start, although San Francisco will not need such vast waters for years to come. This proposed problem of discounting the present value may be tedious in solution. Any proposition, however, of such financial magnitude and which may disturb the irrigation balance in a great commonwealth, is indeed worthy of the greatest care in solution.

The Justification of Workmen's Compensation

The proposed Oregon law on workmen's compensation, briefed elsewhere in this issue, together with the agitation now on in California looking to a revision of the Rosebury law, naturally suggests a timely discussion as to the real justification of workmen's compensation, if at all.

The common law has, since time immemoriam, recognized four fundamental points upon which the master or employer is responsible for damages. First, an injury caused through the wrongful act, neglect or default of himself, foreman or superintendent. He may be held, too, when an injury results from machinery out of repair or unsuited for the use to which it may be put. Failure to provide safe appliances is the third grounds, and, in the fourth place proper warning or instruction not being given, makes the employer liable. On the other hand, the three points upon which damages can not be collected are when an injury is caused by a fellow employe of the injured by the contributing carelessness of the injured party, or from any injury arising out of the usual hazard recognized in the industry.

To view this matter in a manner free from passion, divorced from all partisan spirit, we must for the moment note the bleeding cry that has arisen in the land since the advent of the modern industrial era. Common law found its origin in days when the subtle high voltage wires, the seething molten pot of iron, the crushing burdens of the giant travelling crane, the treacheries of whirring machinery, and a thousand other possible human tortures, not recorded in Dante's Inferno, were totally unknown quantities. To meet the growing demands of society, invention has brought forth a wonderful, new creation—a creation, however, beset with countless pitfalls and dangers. These dangers are so subtle and man so bedazzled with the new order of things, so unaccustomed to handle them to charge the injury to the cost of the industry is but just and reasonable. To say that a commonwealth so protecting its citizens is at a disadvantage in the sale of its products may be a true statement of conditions, but can anyone familiar with the human suffering involved countenance the unjust proportion of life's burden, which the present system necessitates? No. Let us throw the burden of industrial loss on each branch of industry. It will then become an overhead charge against the production of that industry to be eventually borne by society, that master whom all industry serves.

Under such a scheme of compensation we must, however, be cautious, or we may err on the other side of equi-balanced justice. The employer of today spends his thousands for protective equipment, for beautiful grounds, for flowers and receives in return a higher human service. In all industries, known to be hazardous, a higher remuneration is as a rule paid the employe. The hairless chinamen of the New Almaden quicksilver mines, the workers in the giant powder works, and the high salaried aviators of the day, all bear testimony to this fact. While in any event a somewhat higher wage should be paid to the employe as a honorarium against possible human suffering, which no compensation can truly meet, still the proportion of moneys to be paid by the wage-earners and by the employer in the creating of compensation funds is one that merits the most careful consideration. It is clearly unfair to pay the employe a wage befitting a hazardous profession and then, too, demand that the industry care for him or his dependents in event of casualty. The Oregon commission proposes that the employer contribute 6 units, the employe 1 unit and the state 1 unit as a basis of assessment for such funds. Under any scheme, a definite basis of liability must be settled upon, in order that the present curse —litigation—be avoided

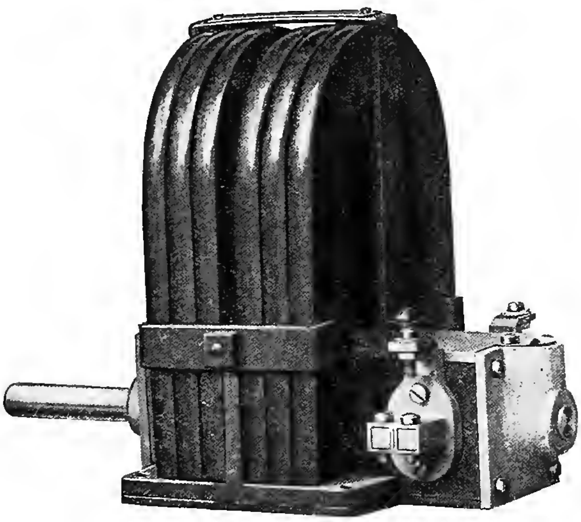
It would seem, too, that although the fundamental reason for accumulating compensation funds is to aid the sick, the dying and their dependents, there should be a reward for care in the avoidance of accidents. To this extent the Oregon law is truly commendable in providing an automatic stoppage of assessments when the protecting larder becomes full to overflowing, due to care and caution on the part of employer and employe. This charging and discharging illustrative of storage battery action, is indeed a happy suggestion to reduce the bleeding casualties of the industries to a minimum.

INDUSTRIAL

ELECTRIC SPEED INDICATOR.

The desirability of knowing the speed of vehicle, machinery, or shafting at any time is something that is now so generally required in every branch of industrial work that a variety of instruments for this purpose have been brought out from time to time. The use, however, of the majority of these indicators is limited to a particular class of apparatus and hence not practicable for use on different applications. For such a universal application the electric indicator, illustrated herewith, is especially adapted.

The electric speed indicator consists of a magneto-generator and a direct current measuring instrument. The magneto is attached to a pulley or shaft of the apparatus the speed of which is to be measured and since the voltage of the magneto-generator is proportional to its speed, the meter, which is properly calibrated, indicates the speed directly at any time. When operating at 1000 revolutions per minute, the magneto generates 25 volts, so that the meter may be calibrated for any unit, as revolutions per minute, cycles per second, percentages fast or slow, or feet per minute.



Electric Speed Indicator.

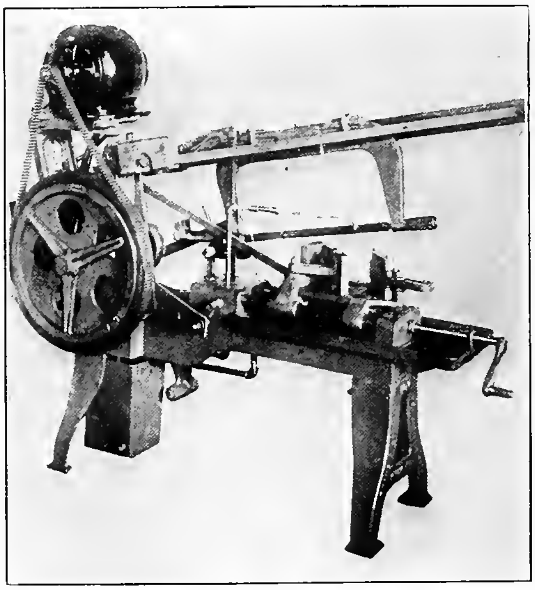
On account of the ease with which these indicators may be adapted to the many types of machinery, they find a wide field of application. The meter may be mounted some little distance from the indicator so that it is possible to place a number of the meters in one place, making it possible for those in charge to note the efficiency of the work in the various departments at any time. In connection with newspaper presses, the application is to note the number of copies being printed at any time or the total number of an edition.

The ability to have a complete record of the operation of the machine is made possible by the use of a graphic meter in connection with the magneto. This use will prove especially beneficial where a test of efficiency of a piece of apparatus is desired. For railway trains, such a meter is a good indicator as to whether or not instructions have been carried out regarding the speed along the line. The large number of railroad wrecks that have occurred within recent years due to failure to comply with speed orders has brought the need of such a device more prominently to the notice of railroad officials.

The indicator is small and can be placed anywhere near the machine, the over-all dimensions being only 6 x 10 x 10 inches and a variety of meters may be used with it. The magneto-generator, which is manufactured by the Holtzer-Cabot Electric Company, is especially designed for use with meters manufactured by the Westinghouse Electric & Manufacturing Company.

NEW HIGH-SPEED HACK SAW, ELECTRICALLY DRIVEN.

A high-speed hack saw, in which the length of the stroke is automatically regulated by the size of the stock held in the vise, is one of the latest devices to which Crocker-Wheeler electric drive has been applied. This metal-cutting machine, the No. 7 Kwik Kut, manufactured by E. C. Atkins & Co. of Indianapolis, Ind., is so constructed that practically the entire blade is utilized at each stroke, regardless of the size of stock, and without attention or changing the machine by hand. This is a distinct advance over the standard length of stroke of about six inches, adopted for most machines in which the length of the stroke can be changed only by hand.



High-Speed Hack Saw.

The cutting capacity of a power hack saw machine is determined by the travel of the blade and the weight of the saw arm. The gain due to the full stroke of the blade automatically obtained in this machine varies from at least 25 per cent on the largest sizes to 100 per cent on the smaller sizes. This also results in a great saving in the use of blades, as the wear on them is distributed over a greater area. The saving in the use of blades is further increased by employing a simple device, by means of which the blade is slightly raised on the return (non-cutting) stroke.

IMPROVED TYPE PORTABLE RAILWAY TELEPHONE.

A new and compact feature has been added to the Kellogg portable telephone, which increases its value in railway service, in the placing of the spool beneath the instrument proper. With this arrangement for winding up the cord the set is made much more compact, and at the same time gives room for plenty of cord.

These instruments are uesd exclusively on one well-known line by linemen, trainmen and officials along the line, and are being permanently installed on many other railroads in the United States.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

Sam Van Ornum, city engineer of Pasadena, is a recent San Francisco visitor.

W. S. Heger has taken up the Pacific Coast representation of Edge Moor Iron Company water tube boilers.

Frank E. Watts, 11th Jupiter of the Jovian Order, expects to make a trip to the Pacific Coast early in 1913 and will be in San Francisco on February 3, 4, 5 and 6.

R. S. Buck of the firm of Sanderson & Porter left this week for New York City. **Wynn Meredith** will leave on January 2. Both will attend the annual meeting of the firm in New York City.

J. P. Zipf, formerly with R. F. Chevalier, consulting engineer, is now engineer for the Ramie Fibre Company of San Francisco. The company is at present engaged in erecting a factory for its fibre products in Oakland, Cal.

H. A. Lardner, Pacific Coast manager of J. G. White & Co., went over the lines of the Oakland & Antioch Railway this week. There is less than 300 feet of tunnel to be driven to complete the connection and this will be done by the end of January, 1913.

C. O. Poole, of Manifold & Poole, consulting engineers of Los Angeles, has recently been operated upon for appendicitis, which made its appearance in a most ugly type. He is now greatly improved and doctors have every confidence for his ultimate recovery

W. W. Briggs, assistant sales manager of the Westinghouse Electric & Manufacturing Company, is receiving congratulations upon his successful efforts in bringing about a gift of $10,000 worth of electrical apparatus from his company to the Panama-Pacific Company.

Walter Clark, electrical engineer of the Victoria Falls & Transvaal Power Company of South Africa, which furnishes power for the big mines of Rand, is at the St. Francis. Clark returned recently from a visit to Alaska, whose mining development greatly interested him.

L. E. Robertson, formerly of the Suburban & Eastern Railroad, with headquarters in Oakland, will succeed H. A. Mitchell as general manager of the Central California Traction Company after the first of the year. Mr Mitchell will assume the position of general manager of the Oakland, Antioch and Eastern Railroad. He will have his headquarters in Stockton.

Sidney R. Inch, retiring general manager of the Missoula Light & Power Company of Missoula, Montana, was given a farewell spread on December 21st by the employees of the company, as stated two weeks ago in these columns. Mr. Inch assumes his new duties at Salt Lake City as general superintendent of the Utah Light and Power Company on New Year's Day.

Charles C. Moore, president of the Panama-Pacific Exposition Company, announces that he will build for Charles C. Moore & Co. a six-story building on the northeast corner of First and Mission streets, purchased a few days ago at auction in the office of A. J. Rich & Co. from Baroness Von Schroder. The building will be erected exclusively for the firm and its engineers, and will be class A. Plans are being prepared and building will commence at once.

H. V. Carter and **W. L Goodwin**, who have been so earnestly engaged for the past month or more with the many details incident to removal of the Pacific States Electric Company to their new home, 575 Mission street, San Francisco, had the satisfaction of seeing their efforts crowned with success. The new quarters were occupied December 23, the date previously set, and it was indeed pleasing to note the spirit of co-operation that prevailed among the entire staff of employees in attaining this result. A formal opening was held in the evening from 7:30 to 10 o'clock, during which time more than a thousand guests were entertained.

LUNCHEON TO JOVIANS AT SEATTLE.

One hundred and twenty-five electrical contractors, dealers, supply men, manufacturers' agents and manufacturers themselves sat down to an electrically prepared lunch November 21, at 1:30, the guests of the Electric Company and the Northwestern Supply Company, complimentary to the Sons of Jove, and others engaged in the business of generating electricity, selling the marketable product and encouraging the use of the current.

Following the luncheon short talks were made by the chairman of the day, Burton R. Stare, of the Northwestern Supply Company; P. J. Aaron, manager of the Western Electric Company; Charles M. Bliven, of the General Electric Company; H. N. Kollock, manager of the Seattle branch of the Westinghouse Company; W. J. Grambs, Superintendent Light and Power, P. S. T., L. & P. Company; Morton Ramsdell, sales manager; James D Ross, superintendent of the city lighting plant; G. I. Kinney, manager of the San Francisco office of the Fort Wayne Electric Company.

The menu distinctive as to the names of dishes, was prepared by Mrs. Elinor M. Redington, demonstrator, who is carrying on a series of lectures and a cooking school for the Puget Sound Traction, Light & Power Company, proselyting the use of electricity for cooking and miscellaneous uses in connection with domestic science. The spread was voted a complete success and enthusiastic endorsement was given to the types of stoves used in preparing the meal, the following being the bill of fare:

Westinghouse Celery. General Electric Olives.
W. E. Co. Cream of Tomato. U. S. Steel Crackers.
Roebling Sweet Pickles.
Roast Turkey, a la Hughes Kendrick, Cranberry Sauce.
Baked Ham, a la Copeman.
Fobes Sweet Potatoes, Southern Style.
Prime Roast Beef, a la Simplex.
Pacific States Sweet Potatoes. Johns-Manville Vittucci Salad.
Holabird "Hot Point" Bread.
Globe June Peas.
Reardon Pineapple Souffle. Gleason Crisco Cake.
Cascade Crescent Cream Coffee. Lushington Mints.
Pacific Lamp Cigarettes. Northwestern Cigars.

OREGON SOCIETY OF ENGINEERS.

John T. Whistler spoke Thursday evening, December 19th, to the members of the Oregon Society of Engineers, at Portland on the general subject of water resources of Oregon. In a presentation of well selected facts involving dormant water resources and the mineral constituents and the feasibility of their utilization, Mr. Whistler clearly showed the enormity of their magnitude. Attention was called to the need of state aid in their development. Principles laid down as fundamental law by commissions of other states were cited as worthy of adoption by the Water Board of Oregon.

Mr. Eugene Brookings, President of the Progressive Business Men's Club, by invitation, spoke upon club work and its attendant results. He strongly urged the intermingling of all organized men in a social way to the end that united energies might be directed toward the accomplishment of those public measures which make for common good.

SAN FRANCISCO ENGINEERS' CLUB.

On account of the holidays the regular weekly luncheons of the Engineers' Club, December 24 and 31, was not held. Tuesday, January 7th, Mr. George Nolan, manager for the Dow Willans Diesel Engine Company, will be the guest of the club and will be prepared to answer questions regarding Diesel engines.

OREGON ELECTRICAL CONTRACTORS' CONVENTION AND JOVIAN MEETING, PORTLAND, OREGON.

This week has been an exceedingly busy one for the Electrical Contractors, as well as all other electrical men in Oregon. The convention was a great success, and its effect will be to unify all electrical interests in Oregon.

On the opening day there were 125 registered at this convention. The papers were exceptionally good and called forth a great deal of discussion.

At 12 o'clock a "buffet" lunch was served in the convention hall, after which the paper reading was resumed. The papers presented were as follows: F. D. Weber, inspector for the Underwriters' Equitable Rating Bureau, read a paper on "The Relations of the Oregon Electrical Contractor to the Underwriter's Inspection Work in Oregon"; F. N. Averill, manager of the Fobes Supply Company, discussed "The Relation of the Electrical Jobber to the Electrical Contractor"; George H. Duffield, special representative of the N. E. C. A., spoke on "What the National Electrical Contractors' Association Is Doing for Electrical Contractors"; O. B. Coldwell made "Some Pratical Statements from a Central Station Expert"; Howard Joslyn, city electrician of Seattle, spoke on "Municipal Inspection"; "Credit—Its Utility in the Modern Commercial World," was the subject of L. B. Smith, and Cost and Efficiency" was discussed by P. L. Proctor, manager of the Pacific Audit Company.

In the evening the contractors, their guests and ladies attended the Orpheum theater, where the actors endeavored to air all their knowledge of electricity and electrical terms to the amusement of a great portion of the audience.

On Wednesday, two special cars took all those desiring to visit the River Mill Plant of the P. R., L. & P. Company's at River Mill, and thence back to Estracada, where a chicken dinner was served. During the dinner Mr. J. E. Werlein, of the P. R., L. & P. Company, kept the "ball rolling" as toastmaster. The day was made complete by having the "Little German Band" along, known locally as the "Hungry Seven."

After returning from this trip the members assembled in the Electric Building and elected officers for the ensuing year. The following officers were elected: Guy Littler, president; H. D. Lockore, first vice-president; W. H. Baker, second vice-president; J. L. Vaughan, third vice-president; L. E. Dawson, fourth vice-president; F. C. Green, secretary; J. R. Tomilson, treasurer.

Wednesday evening a most sumptuous banquet was partaken of at the Multnomah Hotel, there being 110 plates served.

The Jovian luncheon, Thursday was not forgotten and the place was filled to its capacity. Mr. B. L. Josselyn, president of the Portland Railway, Light & Power Company, was the speaker of the day. His speech was very appropriate and voiced the sentiments of the Jovian Order in strong terms.

At 8 p. m. a Rejuvenation was held at the Multnomah Hotel, where 46 candidates were given the honors. This ended a most glorious convention.

NEW BOOKLET ON STORAGE BATTERY OPERATION.

One of the best indications of the simplicity and ease of operation of the electric vehicle when equipped with a dependable battery, is shown in a small book of only six pages just issued by The Electric Storage Battery Company of Philadelphia. It is entitled "Instruction Book for the Operation of "Exide Vehicle Batteries," and gives a remarkably few words all the necessary information which the owner of an "Electric" need possess to keep his battery in good working order. Those who have hitherto imagined the vehicle battery to be a complicated and troublesome piece of apparatus to maintain, should send for a copy of this booklet which covers the instructions for the "Ironclad-Exide," "Exide," "Hycap-Exide" and Thin-Exide" Batteries.

NOTES OF THE CALIFORNIA RAILROAD COMMISSION.

Dec. 11.

A decision was rendered granting permission to the Sierra & San Francisco Power Company to purchase the Gold Mountain Water Company, of Sonora, Tuolumne County, for $27,500.

A decision was rendered establishing rates for the Hawthorne Electric & Water Company, operating in Los Angeles County.

L. W. Warmoth was granted permission to sell his telephone system in Tehama and Glenn Counties to the Pacific Telephone & Telegraph Company for $4500.

Applications for grade crossings were granted as follows: Pacific Electric Railway Company to cross the Southern Pacific near Raymer, Los Angeles County; Southern Pacific to build a spur track across Elm and Sycamore streets, Red Bluff; County of Tulare to construct three public highways over the Southern Pacific near Terra Bella, Tulare County; Southern Pacific to construct a spur track across K street, Fresno; Southern Pacific to construct a sidetrack across Chapman street, in McPherson, Los Angeles County.

A decision was rendered granting the application of the San Francisco-Oakland Terminal Railways for a certificate of public convenience and necessity to exercise franchise rights in Berkeley for the operation of a street railway on Eunice street.

The Commission adopted an annual report form to be used by all electric, gas, water and telephone companies.

Dec. 16.

The city of Palo Alto, after voting the control of its utilties to the Railroad Commission, complained against the rates of the Palo Alto Gas & Electric Company. The defendant applied to the Superior Court of Santa Clara County for a writ of prohibition to prevent the Commission from proceeding to hear the case, contending that the city trustees of Palo Alto had already fixed the rate for the ensuing year and that the Railroad Commission could not act until the end of that year. The decision of the Superior Court sustained the Railroad Commission, enabling it to proceed with the hearing.

Dec. 17.

The Haywards Chamber of Commerce filed a complaint against the San Francisco-Oakland Terminal Railways, charging excessive and irregular rates between Oakland and points as far as Hayward.

Herman G. Walker filed a complaint against the San Francisco-Oakland Terminal Railways, charging that illegal conditions had been inserted in the commutation book contract issued for transportation between San Leandro and Hayward. He asked that these conditions be corrected, that the company be compelled to permit public inspecton of its schedules of fares, and that it cease charging 15 cents fare between Hayward and San Leandro.

Application was filed by the San Francisco-Oakland Terminal Railways, asking for permission to increase the rate between San Leandro and Hayward from 10 to 15 cents. The company has collected 15 cents instead of the published rate of 10 cents, which it asserts was a clerical error.

Dec. 18.

The Commission decided to conduct a series of tests in the Induction Cases, in which the Pacific Telephone & Telegraph Company complained of serious interference with the operation of its telephone lines by induction from high tension power lines in proximity to its wires.

Dec. 19.

Application was filed by the Coast Counties Gas & Electric Company for permission to purchase the Gilroy Gas Works for $25,000 and such additions thereto as were made with the city of Gilroy.

NEWS NOTES

INCORPORATIONS.

RIVERSIDE, CAL.—Articles of incorporation have been filed of the Superior Mutual Water Company, which will have its principal place of business in Riverside, and serve water users in Elsinore. Capital stock is $500,000; directors are Charles P. Waite, P. D. Castlemen, Charles Johnson, D. Harvery, W. S. Durkin.

DOVER, DEL.—The California Railway & Power Company has been chartered with a capital of $60,000,000. The purpose of the company, as indicated by the articles of incorporation, is to take over the United Railroads of San Francisco, the Sierra & San Francisco Power Company, the Coast Valleys Gas & Electric Company and the San Francnsco Electric Railways. The concern will maintain offices in New York and San Francisco.

ILLUMINATION.

OGDEN, UTAH.—The board of city commissioners have passed an ordinance grantng a 40-year franchise for the operation of a gas system in the city to C. A. Boyd.

WATTS, CAL.—Bids will be received up to January 28th, for a franchise to lay and construct a gas pipe system along the public streets and alleys described in the franchise.

ARTESIA, N. M.—The Artesia Light & Power Company have applied for a franchise to install a system of gas works. An election will be held December 28 to decide whether it shall be granted.

NEW WESTMINSTER, B. C.—The city council is negotiating with the Northern Gas & Power Company of Vancouver, to secure plans and specifications for a plant suitable for this city.

CHANDLER, ARIZ.—Chief Engineer Binkley of the Chandler Improvement Company, has stated that poles have been ordered for electric light lines, the system when completed to cover the entire city.

LOS ANGELES, CAL.—The ornamental lighting scheme of Seventh street, from Los Angeles River bed to Hoover street, has been approved by the city council. This will give three miles of street lights of same class as are now in use on Hill street.

LOS ANGELES, CAL.—In accordance with the recommendation of City Electrician R. H. Manahan, the council will pass an emergency ordinance, providing for the advertisement of bids for the maintenance of 3702 old and 750 new electric arc lights during the following year.

PALO ALTO, CAL.—The Railroad Commission has received word that it has been sustained by the Superior Court in the Palo Alto gas case. The city of Palo Alto, by popular vote, recently transferred the control of its utilities to the Railroad Commission, and shortly thereafter complained to the Commission against the rate charged by the Palo Alto Gas & Electric Company. The Palo Alto Gas & Electric Company applied to the Superior Court of Santa Clara County for a writ of prohibition to prevent the Railroad Commission from proceeding to hear the case. The Palo Alto Gas & Electric Company contended that the city trustees of Palo Alto had already fixed the rate for the ensuing year and that the Railroad Commsson could not act until the end of that year. The attorneys for the Commission interposed and have now been sustained by Judge Richards of Santa Clara County. The effect of the decision is to enable the Railroad Commission to proceed with the bearing in the case.

TRANSMISSION.

VANCOUVER, B. C.—A corporation to be known as the Fort Fraser Industrial Corporation, Ltd., backed by some of the most influential men in the province, is to be formed for the express purpose of putting in a big power plant at Fort Fraser.

ELSINORE, CAL.—The Southern Sierras Power Company, through its district Riverside office, has announced the purchase of the Elsinore Electric Light & Power Company, with offices at Elsinore. The new company is under local supervision of District Manager Fred A. Worthley in Riverside. Extensive improvements to the plant are planned, including a new building to house transformers and other necessary apparatus, and the installation of a new pole system.

FRESNO, CAL.—Electricity will soon be transmitted over the new power line from the Coalinga district to San Miguel on the coast, according to a statement by General Manager A. G. Wishon of the San Joaquin Light and Power Company. The new power line will connect the San Joaquin Valley and the Sierra Nevada Mountains with the coast at San Miguel, the power coming from the power plant at Crane Valley. When the "juice" is turned on the county will be ready to supply San Miguel and Paso Robles with power, and the construction of lines beyond those points to furnish power for other coast points is already in progress.

TRANSPORTATION.

ORANGE, CAL.—Bids will be received up to January 8th for a franchise to construct and maintain for fifty years a single or double-track electric railway in certain portions of Orange County in accordance with terms of the franchise.

ORANGE, CAL.—Sealed bids will be received up to January 8th for the franchise applied for granting right to construct and maintain single or double track electric railway in certain portions of Orange, described in said franchise.

RICHMOND, CAL.—Application has been made by the San Francisco, Oakland Terminal Railways for a franchise to construct and operate a railroad for a term of 42 years on McDonald avenue and also in the Canal Subdivision. Sealed bids will be received up to January 13th for the sale of said franchises to the highest bidder.

SAN FRANCISCO, CAL.—The Key Route system, in its plans for so extending its Oakland terminal facilities as to provide a six-track pier from the shore line to the Key Route mole, has made arrangements for maintaining special ferry slips for the use of vessels plying between the mole and North Beach during the 1915 Exposition.

STOCKTON, CAL.—That the Calaveras Copper Company, operating big mines at Copperopolis, plans to build a line connecting its mines with another road leading into Stockton is the statement of Charles M. Hayden of Boston, president of the company. Mr. Hayden was in Stockton not long ago, accompanied by J. H. Trerise, superintendent of the company. Mr. Hayden asserts that the company will decide on one of three surveyed routes, that the road will be sixteen miles long, that it will cost about $200,000, and will be in operation by next August.

MADERA, CAL.—J. S. Harker, president of the Mountain Progressive Club of Coarse Gold, will make an effort to interest the Madera Chamber of Commerce in a project to construct an electric road from Madera to Yosemite Valley. His proposition is to store the waste waters of the North Fork

watershed and utilize them for developing electric power for such a railway. Mr. Harker's object is to employ a competent engineer to make the surveys and gather all the data possible in regards to power, cost of construction, equipment, etc., and place this data before capitalists with a view to interesting them.

SACRAMENTO, CAL.—The Northern Electric Railway, through its subsidiary, the Sacramento & Woodland, has filed a suit with the Railroad Commission against the Southern Pacific to force it to restore a connecting track at Mikon, near Sacramento, and for such other action as the commission might deem proper. The Southern Pacific installed its connecting track in December, 1911, for the transfer of heavy shipments of material used in the construction work on the Northern Electric branch. Although the Northern Electric had remaining about 5000 tons of crushed rock to be delivered at Mikon, the Southern Pacific on November 22 gave notice that on November 29 the connecting track would be discontinued. The complaint alleges a violation of the public utilities act in that thirty days' notice of the proposed change was not given to the Railroad Commission.

SAN FRANCISCO, CAL.—The Supervisors have passed an ordinance granting the United States Railroad Company a revocable permit to extend its tracks from Polk and Bay streets along the latter to the Fort Mason Reservation, connecting with tracks to be laid there. The bill also provided for a section of Laguna street, adjoining the reservation, being used for a loop. The city attorney advised the Supervisors that there is no legal objection to the granting of permission to the United Railroads to abandon the use of the tracks on East street, between Howard and Folsom, and on Folsom, between Steuart and East, a change having been made necessary because of the building of the Belt Railway. The company proposes to route its Folsom street cars to the ferries hereafter by way of East and Howard streets.

SAN FRANCISCO, CAL.—Thornwell Mullally, assistant to the president of the United Railroads says: "The California Railway & Power Company will be operated without debts. Its prior preference stock will be issued under careful restrictions for money for the improvement and extension of the companies it controls. By this method the United Railways Investment Company subordinates its equities in the California properties controlled by it to the fresh money required from time to time in the service of the communities in which the operating companies do business. We will pay on January 1 every bill payable of the United Railroads of San Francisco. We are put in ample funds for future improvements both of the railroad and of the power interests. Without issuing any new bonds or any stock on the United Railroads, that is, without any increased capitalization of that road, we will get cash with which we can and will not only pay off all the debts of the company, but will have ample funds for future improvements."

SAN FRANCISCO, CAL.—Plans for a great railway terminal capable of handling the business of the new Oakland municipal wharves have been completed by the Key Route system. The plans call for the construction of a six-track pier from Oakland's shore line to the Key Route mole, a distance of three and a half miles, at an approximate expense of $2,000,000. They call for the construction of spur and side tracks from the new six-track pier to the district bordering on the municipal wharves, as well as from the present Fourteenth street extension to the municipal wharves, and an enlargement of the present train sheds. The San Francisco, Oakland & San Jose Terminal Railways, the name under which the Key Route properties now operates, will shortly present its plans for an extension of its present rail facilities to the Railroad Commission. So far has the Key Route's plans for the six-track system advanced that the Key Route financiers are already negotiating with contractors for the work of driving the piles. But this is not all. The Key Route backers, convinced that the present mole will be insufficient to adequately handle the traffic they think is bound to accrue, are preparing an extensive enlargement of the present mole facilities. These plans include a greater train shed. They include also a vast extension of the present trackage facilities of the Key Route altogether with the six-track pier system, involving an expenditure of over $7,000,000 before the opening of the 1915 exposition.

TELEPHONE AND TELEGRAPH.

COLFAX, WASH.—The Inland Telegraph & Telephone Company of Spokane has applied for a franchise in Whitman County.

LOS ANGELES, CAL.—The American District Telegraph Company has been granted a franchise to install conduits or string wires in the city streets.

PLACENTIA, CAL.—The Pacific Telephone and Telegraph Company is improving its service in this district by changing its eight-party lines to six-party lines.

SAN DIEGO, CAL.—The Pacific Telephone and Telegraph Company has applied for a permit to construct a three-story brick and concrete exchange building at Seventh and University. The cost is estimated at $30,000.

RIALTO, CAL.—The Pacific Telephone & Telegraph Company has been granted a franchise to erect poles, wires and other appliances for the transmission of electricity for telegraph and telephone purposes along certain streets named in the franchise.

NAPA, CAL.—D. C. Priest has been granted permission to erect poles and suspend wires for a telephone line over a route from the stone bridge near St. Helena thence up Howell Mountain road to the junction of that road with the Chiles Valley and Rutherford roads.

WATERWORKS.

FULLERTON, CAL.—Sealed bids will be received up to December 27th, for furnishing all labor and material for the construction of a municipal water system.

LOS ANGELES, CAL.—A certificate of removal of principal place of business of Elsinore Land & Water Company from Elsinore to Los Angeles has been filed.

EUREKA, CAL.—Three thousand inches of water from the west branch of Willow Creek have been secured by the Bonnieville Mining Company for development purposes.

WICKENBURG, ARIZ.—The Curry waterworks plant, which supplies the Collins and Curry additions and other sections of the town, has been taken over by C. W. Jennings.

REDLANDS, CAL.—Plans and specifications have been completed for a municipal water system, and the commission has recommended that the city trustees advertise for bids for its construction.

MARSHFIELD, ORE.—The town of Bandon is arranging to install a municipal water system. A special election has been called for February 25th, when the voters will pass on the question of issuing about $200,000 worth of bonds. Of this amount, it is planned to spend $150,000 on the water system.

TUCSON, ARIZ.—A. H. Frost, banker of San Diego, has petitioned the department of fomento, asking for a concession to use 5000 liters of water per second from Arroyo De Tijuana, Lower California, for the purpose of installing a water system in the town of Tiajuana for domestic use. The petition asked for the right to construct the needed dams within five years.